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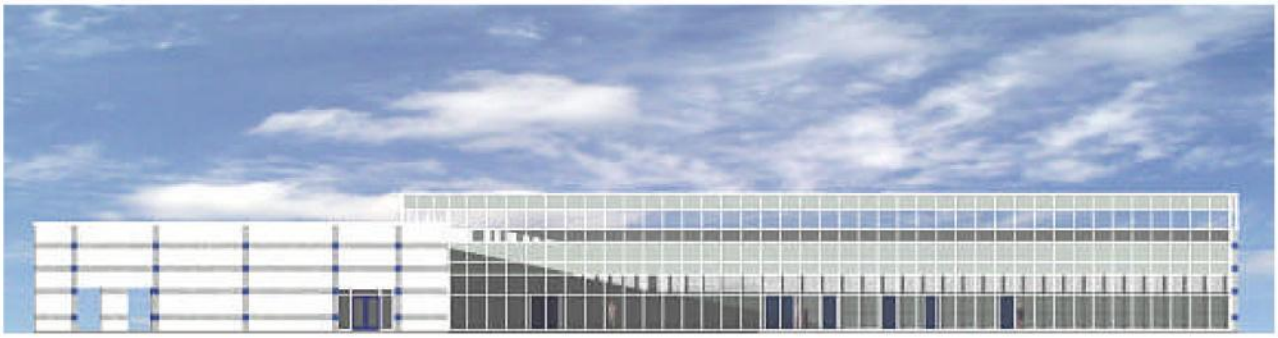
ENVIRONMENTAL IMPACT STATEMENT



Proposed Leasing of Lands at Fort Bliss, Texas for the Proposed Siting, Construction, and Operation by the City of El Paso of a Brackish Water Desalination Plant and Support Facilities

JULY 2004

Proposed Leasing of Lands at Fort Bliss, Texas for the Proposed Siting, Construction, and Operation by the City of El Paso of a Brackish Water Desalination Plant and Support Facilities

Draft Environmental Impact Statement

PREPARED FOR:

Byron E. Greenwald
Colonel, U.S. Army
Commanding
Fort Bliss, Texas

1 July 2004
Date

REVIEWED BY:

Keith Landreth
Director of Environment
Fort Bliss, Texas

1 July 2004
Date

REVIEWED BY:

Lawrence Sansone
Colonel, EN
Director of Public Works and Logistics
Fort Bliss, Texas

1 July 2004
Date

APPROVED BY:

Hugh M. Exton, Jr.
Director
SWRO, Installation Management Agency

3 Aug 04
Date

Proposed Leasing of Lands at Fort Bliss, Texas for the Proposed Siting, Construction, and Operation by the City of El Paso of a Brackish Water Desalination Plant and Support Facilities

Draft Environmental Impact Statement

PREPARED FOR:

U.S. Army Air Defense Artillery Center and Fort Bliss
Directorate of the Environment
Fort Bliss, Texas and New Mexico 79916

PREPARED BY:

U.S. Army Corps of Engineers
Fort Worth District
819 Taylor Street
Fort Worth, Texas 76102

TECHNICAL ASSISTANCE:

Science Applications International Corporation
2109 Airpark Road
Albuquerque, NM 87106

July 2004

COVER SHEET

Lead Agency: U.S. Army, Fort Bliss

Title of Proposed Action: Proposed Leasing of Lands at Fort Bliss, Texas for the Proposed Siting, Construction, and Operation by the City of El Paso of a Brackish Water Desalination Plant and Support Facilities

For Further Information Contact:

Mr. John Barrera, NEPA Coordinator
Directorate of Environment
Bldg. 624, Pleasonton Road
Fort Bliss, TX 79916-6812
Telephone: (915) 568-3908

Designation: Draft Environmental Impact Statement (DEIS)

Abstract: The U.S. Army proposes to provide an easement for land in the South Training Areas of Fort Bliss to the City of El Paso, El Paso Water Utilities (EPWU) for construction and operation of a desalination plant and supporting facilities, including wells, pipelines, disposal facilities, roads, and utilities. The purpose of the proposed plant is to treat brackish (salty) water pumped from the Hueco Bolson Aquifer to provide potable water for use by the City of El Paso and Fort Bliss. The plant would use a process called reverse osmosis to remove salts from the brackish water, producing drinking water and a highly concentrated salt water, called "concentrate," that must be disposed of. The Army is considering three alternative sites for the desalination plant and two alternative disposal methods for the concentrate, deep-well injection and evaporation. This DEIS analyzes the environmental effects of six action alternatives, comprising various combinations of plant sites and disposal alternatives, and the No Action Alternative. The findings of the DEIS indicate that pumping brackish water from proposed new wells instead of existing freshwater wells would prolong the useful life of freshwater resources in the Hueco Bolson Aquifer and slow the intrusion of brackish water on existing Fort Bliss water wells. Initial tests of deep-well injection indicate that there is a confined area underground capable of accepting the concentrate without adversely affecting drinking water sources. Use of deep-well injection would require a permit from the Texas Commission on Environmental Quality (TCEQ). Alternatively, disposal of the concentrate through evaporation in surface ponds adjacent to the Fred Hervey Wastewater Reclamation Plant, which also requires a TCEQ permit, could be toxic to birds.

Comments can be submitted to the above Contact address postmarked through: September 27, 2004

SUMMARY

This Environmental Impact Statement (EIS) is being prepared to assist the United States (U.S.) Army in making a decision on a request by the City of El Paso, El Paso Water Utilities (EPWU) to acquire an easement for land at Fort Bliss, Texas, for construction and operation of a desalination plant and its supporting infrastructure. The EIS, hereafter referred to as the Fort Bliss Desalination EIS, complies with the National Environmental Policy Act of 1969, as amended (42 *United States Code* 4321 *et seq.*), implementation regulations adopted by the Council on Environmental Quality (40 *Code of Federal Regulations* [CFR] 1500 *et seq.*), and U.S. Army Regulation 200-2 (32 CFR Part 651).

PURPOSE OF AND NEED FOR ACTION

The Army is preparing the Fort Bliss Desalination EIS to understand the environmental consequences that could result from granting an easement to the City of El Paso to use land in the South Training Areas of Fort Bliss for construction and operation of the proposed desalination plant and support facilities, including wells, pipelines, and disposal sites for the residual waste resulting from the desalination process.

The purpose of the proposed plant is to treat brackish (salty) water pumped from the Hueco Bolson Aquifer to provide potable water for use by the City of El Paso and Fort Bliss. The Hueco Bolson contains both potable and nonpotable brackish water. Potable water from the aquifer is currently pumped by Fort Bliss, the City of El Paso, small communities in Texas and New Mexico, and Ciudad Juárez, Mexico.

The objective of the proposed action is to provide an additional reliable source of potable water for the city and Fort Bliss. While the City of El Paso also obtains water from other sources, most of the potable water used by Fort Bliss is supplied by wells that draw water from the Hueco Bolson. Withdrawals of fresh water currently exceed the aquifer's recharge rate. Pumping of fresh water by EPWU, Fort Bliss, Ciudad Juárez, and others has resulted in declining groundwater levels in the bolson. The rate of decline has been less in the last 10 years in the El Paso area due to decreased pumping, but it continues to be a groundwater management challenge. In addition, brackish water is intruding into the aquifer's freshwater layer and has the potential to affect water wells on Fort Bliss and in other areas of El Paso.

A sizable volume of brackish water exists adjacent to the freshwater zone of the Hueco Bolson Aquifer. Desalination of the brackish deposits offers a way to extend the life of the freshwater aquifer as a source of potable water that is to the mutual benefit of Fort Bliss and the City of El Paso.

The proposed desalination plant would reduce withdrawals of fresh water from the bolson, extending the useful life of the aquifer and intercepting the flow of brackish water to wells that are operated by Fort Bliss. Both Fort Bliss and the City of El Paso have considered constructing desalination facilities to tap into this potential water source. The Army and EPWU believe that building a single desalination plant to provide potable water for both the installation and the city would be more efficient and cost effective than constructing separate desalination plants.

ALTERNATIVES CONSIDERED INCLUDING THE PROPOSED ACTION AND NO ACTION ALTERNATIVE

The proposed desalination plant would treat brackish water drawn from the Hueco Bolson, referred to as "feed" water, using a technology called reverse osmosis (RO). RO uses semipermeable membranes to remove dissolved solids (primarily salts) from brackish water, producing fresh water. The result is two water streams: fresh water (called "**permeate**") and a concentrated brine formed from the salt removed from the brackish feed water (called "**concentrate**"). The permeate would be very pure, whereas drinking water contains some minerals, including salt. Therefore, the permeate would be mixed with brackish "blend" water, also drawn from the Hueco Bolson, prior to distribution in the public water supply. This procedure would also increase the volume of water output from the desalination plant. The blended water is called "finished" water. The finished water from the plant would comply with federal and state drinking water standards and be suitable for use as drinking water. The concentrate would have high total dissolved solids content (primarily salt and other minerals that occur in the feed water), more than 5,000 milligrams per liter, and would require disposal.

The plant is being designed to treat approximately 18.5 million gallons per day (MGD) of brackish water pumped from 15 existing EPWU feed wells to produce an estimated 15.5 MGD of permeate and 3.0 MGD of concentrate. The exact amount of permeate and concentrate would depend on a number of factors, including how brackish the feed water is and the efficiency of the RO process. Approximately 12.0 MGD of blend water would be pumped from 16 new blend wells and added to the permeate to yield approximately 27.5 MGD of finished water.

To implement the proposed desalination project, EPWU is applying for an easement for land in the South Training Areas of Fort Bliss for the following facility sites:

- **Desalination Plant Site.** This site would house the proposed desalination plant, ancillary buildings, utilities, access driveways, and parking areas. EPWU has requested that this site be located near its Montana Booster Station and existing water wells on the east side of El Paso International Airport (EPIA), in order to minimize the length of pipelines required and the ground disturbance associated with pipeline installation.
- **Concentrate Disposal Site.** Two disposal methods are being considered for the concentrate. One involves disposal underground through three to five injection wells located in the northeast corner of the South Training Areas. These wells would inject the concentrate deep underground into a confined zone where it would be isolated from potable water sources. The location of the deep-well injection wells is dependent on suitable geologic conditions that preclude the possibility of the concentrate degrading the quality of groundwater.

  The other disposal method under consideration involves piping the concentrate to evaporation ponds, where the liquid will evaporate leaving a solid salt residue that would be trucked to a landfill for final disposal. EPWU has identified its existing Fred Hervey Water Reclamation Plant as the location for the evaporation ponds. Additional adjacent land on Fort Bliss would be obtained to provide sufficient area to accommodate the projected volume of concentrate to be evaporated.
- **Wells and Pipeline Corridors.** Brackish water for desalination would be obtained from the Hueco Bolson using the existing EPWU feed wells located on city land on the east side of EPIA and would be conveyed through underground pipes to the desalination plant for treatment. Sixteen new blend wells would be located on Fort Bliss land along Loop 375 to provide water for blending with the permeate. The blend water would also be conveyed through underground pipes to the plant. Other underground pipes would convey the finished water produced at the plant to the city's water distribution system and transport the concentrate to the deep-well injection site or

evaporation ponds. Many of these pipelines would follow existing utility easements across the South Training Areas.

The total amount of Fort Bliss land needed by EPWU depends on the concentrate disposal method selected and the final locations of the desalination plant and pipelines. **Table S-1** provides the approximate acreage required for each project component.

Table S-1. Approximate Acres of Army Land Required for the Proposed Project Components

Project Component/Site	Approximate Acreage
Desalination Plant Site and Pipelines from Feed Wells	36.5
Blend Well Sites (16)	3.7
Pipelines from Blend Wells to Plant	35.8
Concentrate Pipeline to Deep-Well Injection Site (from Loop 375)	57.4
Deep-Well Injection Sites (3-5)	0.7-1.1
Concentrate Pipeline to Evaporation Ponds	25.8
Evaporation Ponds (Fort Bliss land only)*	394.0

* Total land area required for evaporation ponds estimated at 680.5 acres.

This EIS analyzes six action alternatives and the No Action Alternative. The action alternatives are listed in **Table S-2**. They include various combinations of three potential sites for the proposed desalination plant and two methods of disposal of the concentrate that results from the desalination process. The location of each of these sites is shown on **Figure S-1**.

Table S-2. Summary of the Action Alternatives

Action Alternative	Desalination Plant Location [a]	Method for Concentrate Disposal
1	Site 1	Deep-well injection
2	Site 2	Deep-well injection
3	Site 3	Deep-well injection
4	Site 1	Evaporation ponds
5	Site 2	Evaporation ponds
6	Site 3	Evaporation ponds

[a] See Figure S-1

Under the No Action Alternative, the Army would not provide land on Fort Bliss for construction and operation of the proposed desalination plant. None of the proposed facilities would be constructed on Army land at Fort Bliss. This alternative could, however, include one of the following actions without Army action or participation:

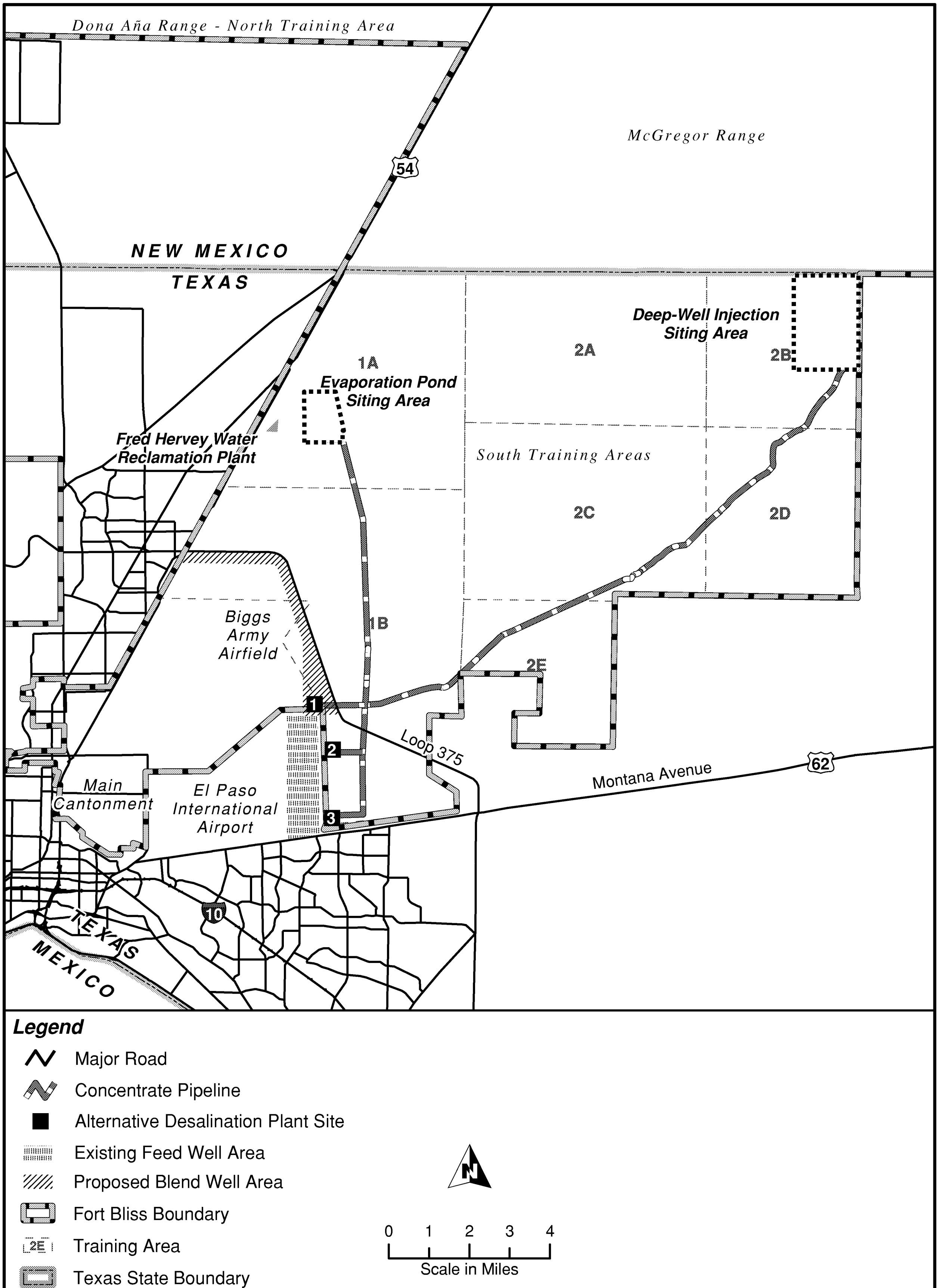


Figure S-1. Alternative Locations for the Proposed Desalination Plant and Disposal Sites

- Construction and operation of a desalination plant on non-Army land (e.g., Dell City);
- Increase in water conservation measures;
- Development of other water sources in the El Paso region;
- Importation of water from areas outside El Paso.

Without the proposed desalination project, both Fort Bliss and EPWU would continue to pump from the freshwater layer of the Hueco Bolson until it no longer met drinking water standards. The quantity of withdrawals would depend on demand, the effectiveness of water conservation measures, and the availability of other water sources, and is expected to be approximately the same whether or not the proposed desalination plant is built. While EPWU currently plans to pump approximately the same quantity of water as under the action alternatives, under the No Action Alternative, the withdrawals would occur from the freshwater layer of the bolson instead of from the brackish layer.

COMPARISON OF ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

The six action alternatives listed in Table S-2 and the No Action Alternative were analyzed to identify potential effects in the following ten areas:

- Geology and Soils
- Water Resources
- Utilities and Services
- Hazardous Materials, Hazardous Waste, and Safety
- Air Quality
- Biological Resources
- Land Use and Aesthetics
- Transportation
- Cultural Resources
- Socioeconomics and Environmental Justice

A brief summary of impacts of each alternative is provided below.

Alternative 1

Under this alternative, construction of the desalination plant site and access road would disturb approximately 72-73 acres, increasing the risk of erosion and increasing short-term air pollutant emissions. During operation of the plant, there would be an increase in power consumption. Hazardous materials would be stored and used at the plant site, and there would be a slightly increased risk of an accidental spill of hazardous materials or waste at the site or during transportation of chemicals to or from the site. The development of Site 1 could conflict with the alignment of a planned connection from Loop 375 to EPIA and would require redesign of the access around the site. EPIA is in the process of revising its Master Plan.

Traffic would increase slightly along Montana Avenue and Loop 375. Access to Site 1 would be along a new roadway from Montana Avenue, which could have a minor adverse impact on traffic flow along this already congested route. Montana Avenue provides access to residential areas to the south and east, including areas that have higher than average minority and low-income populations.

Construction of the blend wells and the pipelines from the feed wells and blend wells to the plant site would disturb about 61-62 acres. Pumping from the existing feed wells would increase drawdown (lowering of the water table) of the groundwater level in the immediate vicinity of the wells by up to 90 feet, which would be up to 60 feet more than the drawdown projected without the desalination project. This could increase subsidence in the area around the desalination plant to a minor extent. The magnitude of the drawdown would diminish with distance out to about 5-10 miles around the plant site. A similar although less pronounced drawdown would occur around the new blend wells. In order to pump the same total quantity of water from the aquifer as would be pumped without the desalination project, EPWU's plan is to reduce pumping from its other wells northwest of the project area. The reduced pumping would have the beneficial effect of impeding intrusion of higher salinity water into the area of the blend wells and existing water wells on Fort Bliss.

Construction of deep-well injection wells would disturb less than a quarter of an acre of land and vegetation at each of three to five injection sites and about 91-92 acres for installation of the concentrate pipeline from Loop 375 to the injection site. There would be a small risk of contamination of soil and the surficial aquifer with salts from the concentrate if there were a break or leak in the pipeline. Injection of concentrate at the wells could slightly increase the risk of localized low-intensity earthquakes by changing internal pressures within geologic formations. The injection site is located near a geothermal resource, and there is a small risk that deep-well injection of cooler water could interfere with future exploitation of this resource. However, available evidence indicates that concentrate injection would not affect geothermal resources. All other impacts would be negligible.

Alternative 2

The impacts from development of Alternative 2 would be essentially the same as Alternative 1. Total area disturbed during construction would be about 7 acres more than under Alternative 1. The desalination plant in this alternative would be exposed to a slightly higher level of noise from aircraft operations at EPIA and Biggs Army Airfield than under Alternative 1. However, the noise level would not be incompatible with the industrial activities at the plant.

Alternative 3

The impacts from development of Alternative 3 would be similar to Alternatives 1 and 2. Ground disturbance during construction would be about the same as Alternative 1. Although the distances between Plant Site 3 and the blend wells and the injection site would be longer, the access road would be shorter. Plant Site 3 is located in an area identified by EPIA for possible future industrial development, although EPIA is in the process of updating its Master Plan. If this site is selected for a desalination plant, other development would have to be located around the plant. This is not expected to adversely affect EPIA plans. The plant would be compatible with the type of industrial development anticipated by EPIA.

Alternative 4

Alternative 4 would have the same impacts from construction and operation of the desalination plant, blend wells, and feed and blend well pipelines as Alternative 1. It would differ in the impacts associated with disposal of the concentrate. The impacts from deep-well injection described for Alternative 1 would not occur under Alternative 4.

The construction of evaporation ponds would disturb as much as 748-749 acres of soil and vegetation with associated increase in soil erosion and dust emissions. After construction, about 680 acres would be converted into evaporation ponds. The increased ground disturbance for the ponds would be offset somewhat by the shorter length of the concentrate pipeline, which would disturb about 62-63 acres compared to the 91-92 acres disturbed under Alternative 1. The net difference would be about 703-718 more acres disturbed for the evaporation pond alternatives than the deep-well injection alternatives.

The ponds would be large and very visible, especially from elevated locations, although the existing landscape in this area is relatively featureless and undistinguished. During operation, there would be a minor risk of contamination of soil and the surficial aquifer by concentrate due to leaks or breaks in the pond liner or the pipeline leading from the desalination plant to the ponds. During certain weather conditions, there is a possibility that odors from the ponds would be noticeable from nearby residential areas, although they are not expected to be stronger than odors currently experienced from the existing oxidation ponds at the Fred Hervey Wastewater Reclamation Plant and a neighboring food processing plant.

The evaporating concentrate would have the potential to cause salt toxicosis and other toxicity in birds attracted to the ponds. If a large number of birds were attracted to the area, there would be a small risk of an outbreak of avian botulism. However, this site is not known to be used by large numbers of birds.

The evaporation ponds would produce approximately 100 tons per day of solids (primarily salt) requiring disposal in an appropriate landfill. This could exacerbate landfill capacity issues in El Paso.

Alternative 5

The impacts of this alternative would be essentially the same as Alternative 4. Ground disturbance during construction would be about the same. Desalination plant Site 2 would be exposed to slightly higher aircraft noise levels than Site 1.

Alternative 6

This alternative would be similar to Alternatives 4 and 5, with about 8 acres less of ground disturbance than Alternative 4. Land use impacts associated with desalination plant site would be slightly higher, as described for Alternative 3.

No Action Alternative

If this alternative were selected, none of the impacts described above would occur on Fort Bliss land. Similar impacts could occur if a desalination project were developed on land outside Fort Bliss. If no desalination plant is built, freshwater supplies in the Hueco Bolson will continue to be depleted at a faster rate than with the proposed project. The length of time that freshwater resources would continue to be usable is not known and depends on other factors such as the amount of pumping, the effectiveness of conservation measures, drought conditions, and availability of other water sources. With continued pumping from existing EPWU freshwater wells, the intrusion of saline waters toward Fort Bliss wells would continue.

EASEMENT CONDITIONS AND MITIGATION MEASURES

If an easement is granted by the Army to EPWU for construction and operation of the proposed desalination project, it will include conditions to protect the military mission and avoid or mitigate adverse environmental impacts. In some cases, monitoring will be conducted to verify compliance with the conditions, assess the effectiveness of the mitigation measures, or provide data that might trigger additional mitigation. **Table S-3** lists identified conditions and mitigation measures and indicates which would involve monitoring.

Table S-3. Easement Conditions, Mitigation Measures, and Monitoring

Resource	Condition/Mitigation Measure	Monitoring	Alternative
Geology and Soils	Use dust suppression measures such as watering and application of soil stabilizers during ground disturbance (also Air Quality).		1–6
	Install pressure monitors in the concentrate pipelines to detect leaks and/or catastrophic failure.	X	1–6
	Install a leak detection system under the evaporation ponds to allow early leak detection and corrective action.	X	4–6
Water Resources	Install pressure monitors in the concentrate pipelines to detect leaks and or catastrophic failure.	X	1–6
	Develop an emergency action plan to minimize the release of concentrate during an accident or equipment failure.		1–6
	Evaluate the presence or absence of a connection between the injection zone and other aquifers during deep-well injectivity tests.		1–3
	Install a leak detection system under the evaporation ponds to allow early detection and corrective action should leaks occur.	X	4–6
Air Quality	Water exposed soil frequently during construction to minimize fugitive dust.		1–6
Biological Resources	Avoid disturbing any arroyo vegetation that may be present.		1–3
	Maintain fresh water in the Fred Hervey oxidation ponds during bird migration to minimize potential salt toxicosis.		4–6
	Monitor bird deaths at the evaporation ponds for possible toxicosis and to determine whether further mitigation measures need to be implemented.	X	4–6
	Monitor chemical concentrations in evaporation ponds quarterly and conduct screening-level toxicological risk assessments every five years.	X	4–6
Transportation	EPWU coordinate access requirements with Fort Bliss to ensure maintenance of the deep-well injection facility and concentrate pipelines can be performed with minimal interference with the Fort Bliss mission.		1–3
	Design the entry and exit road from the desalination plant to Montana Avenue to minimize impact to traffic flow.		1–6

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1 PURPOSE OF AND NEED FOR ACTION

1.1 BACKGROUND

This Environmental Impact Statement (EIS) is being prepared to assist the United States (U.S.) Army in making a decision on a request by the City of El Paso, El Paso Water Utilities (EPWU) to acquire an easement for land at Fort Bliss, Texas, for construction and operation of a desalination plant and its supporting infrastructure. The EIS, hereafter referred to as the Fort Bliss Desalination EIS, complies with the National Environmental Policy Act (NEPA) of 1969, as amended (42 *United States Code* [USC] 4321 *et seq.*), implementation regulations adopted by the Council on Environmental Quality (CEQ) (40 *Code of Federal Regulations* [CFR] 1500 *et seq.*), and U.S. Army Regulation 200-2 (32 CFR Part 651).

The purpose of the proposed plant is to treat brackish (salty) water pumped from the Hueco Bolson Aquifer to provide potable water for use by the City of El Paso and Fort Bliss. The Hueco Bolson contains both potable and nonpotable brackish water. Potable water from the aquifer currently supplies Fort Bliss, the City of El Paso, and Ciudad Juárez, Mexico.

Fort Bliss is a U.S. Army installation located on approximately 1.12 million acres in Texas and New Mexico. The installation's principal mission is the U.S. Army Air Defense Artillery Center and Fort Bliss. Fort Bliss is a multi-mission installation providing support for training, testing, mobilization, and deployment in a single-service, joint, or combined arms environment (U.S. Army 2000). The primary components of the installation include the Main Cantonment and the South Training Areas in Texas, and the Doña Ana Range-North Training Areas and McGregor Range in New Mexico.

This chapter describes the objectives of the proposed action, the scope of the EIS, decisions that will be made pursuant to the completion of the EIS, related environmental documents, the public involvement process conducted for the EIS, and regulatory and permit requirements associated with implementing the proposed action.

1.2 OBJECTIVES OF THE PROPOSED ACTION

The Army is preparing the Fort Bliss Desalination EIS to understand the environmental consequences that could result from granting an easement to the City of El Paso for construction and operation of the proposed desalination plant and support facilities. The purpose of the proposed easement is to respond to a request from the City of El Paso, EPWU, to use land in the South Training Areas of Fort Bliss for the proposed facilities, including wells, pipelines, and disposal sites for the residual brine resulting from the desalination process. **Figure 1–1** shows the general project area.

The objective of the proposed action is to provide an additional reliable source of potable water for the city and Fort Bliss, both of which currently draw potable water from the Hueco Bolson Aquifer, which also supplies potable water for Ciudad Juárez, Mexico, and small communities in Texas and New Mexico. While the City of El Paso also obtains water from other sources, most of the potable water used by Fort Bliss is supplied by wells that draw water from the Hueco Bolson. Withdrawals of fresh water currently exceed the aquifer's recharge rate. Pumping of fresh water by EPWU, Fort Bliss, Ciudad Juárez, and others has resulted in declining groundwater levels in the bolson. The rate of decline has been less in the last 10 years in the El Paso area due to decreased pumping, but it continues to be a groundwater management challenge. In addition, brackish water is intruding into the aquifer's freshwater layer and has the potential to affect water wells on Fort Bliss and in other areas of El Paso.

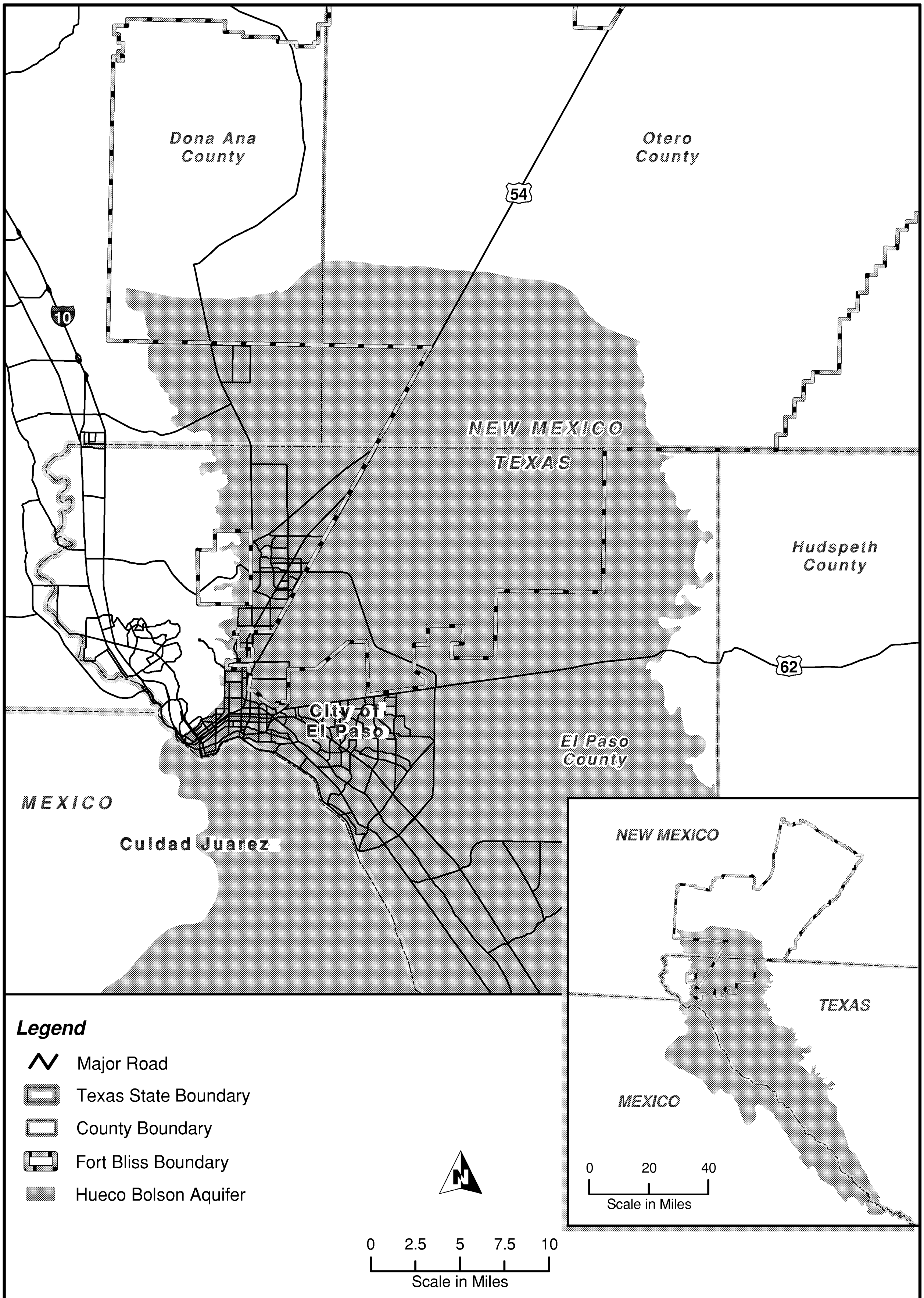


Figure 1-1. General Region of the Proposed Action

A large volume of brackish water exists adjacent to the freshwater zone of the Hueco Bolson Aquifer (TWDB 2001). Desalination of the brackish deposits offers a way to extend the life of the aquifer as a source of potable water that would mutually benefit Fort Bliss and the City of El Paso.

The proposed desalination plant would reduce withdrawals of fresh water from the bolson, extending the useful life of the aquifer and intercepting the flow of brackish water to wells that are operated by Fort Bliss. Both Fort Bliss and the City of El Paso have considered constructing desalination facilities to tap into this potential water source. The Army and EPWU believe that building a single desalination plant to provide potable water for both the installation and the city would be more efficient and cost effective than constructing separate desalination plants.

1.3 SCOPE OF THE EIS

This EIS evaluates the environmental impacts that could result from the Army's decision to provide an easement to EPWU for use of Fort Bliss land to construct and operate the proposed desalination facilities. EPWU has applied for use of sites in various locations of the South Training Areas for the proposed desalination plant, wells, pipeline corridors, required utilities, and disposal of the residual brine, either through deep underground injection or evaporation ponds. **Figure 1-2** shows the general locations under consideration for the following facility sites:

- **Desalination Plant Site.** This site would house the proposed desalination plant, ancillary buildings, utilities, access driveways, and parking areas. EPWU has requested that this site be located near its Montana Booster Station and existing water wells on the east side of El Paso International Airport (EPIA), in order to minimize the length of pipelines required and the ground disturbance associated with pipeline installation.
- **Concentrate Disposal Site.** The desalination process produces potable water and a concentrated brine formed from the salt removed from the brackish feed water. This brine is referred to as "**concentrate**." Two disposal methods are being considered for the concentrate. One involves disposal underground through deep-well injection into a confined zone where it would be isolated from potable water sources. The location of the deep-well injection site is dependent on suitable geologic conditions that preclude the possibility of the concentrate degrading the quality of groundwater. Based on studies conducted by EPWU and the U.S. Army Corps of Engineers (EPWU and USACE 2003), an area in the northeast corner of the South Training Areas shown on Figure 1-2 has been identified for one or more deep-well injection sites.

  The other disposal method under consideration involves piping the concentrate to evaporation ponds, where the liquid will evaporate leaving a solid salt residue that would be trucked to a landfill for final disposal. EPWU has identified its existing Fred Hervey Water Reclamation Plant as the location for the evaporation ponds. Additional adjacent land on Fort Bliss would be obtained to provide sufficient area to accommodate the projected volume of concentrate to be evaporated.
- **Wells and Pipeline Corridors.** Brackish water for desalination would be obtained from the Hueco Bolson using the existing EPWU feed wells located on city land on the east side of EPIA and would be conveyed through underground pipes to the desalination plant for treatment. Water obtained from desalination is called "**permeate**." The permeate would be mixed or blended with brackish water from new wells located on Fort Bliss land along Loop 375, which would also be conveyed through underground pipes to the plant. This water is referred to as "blend" water and the proposed new wells along Loop 375 as "blend wells." Other underground pipes would convey the drinking water produced at the plant to the city's water distribution system and transport the concentrate to the deep-well injection site or evaporation ponds. Many of these pipelines would follow existing utility easements across the South Training Areas.

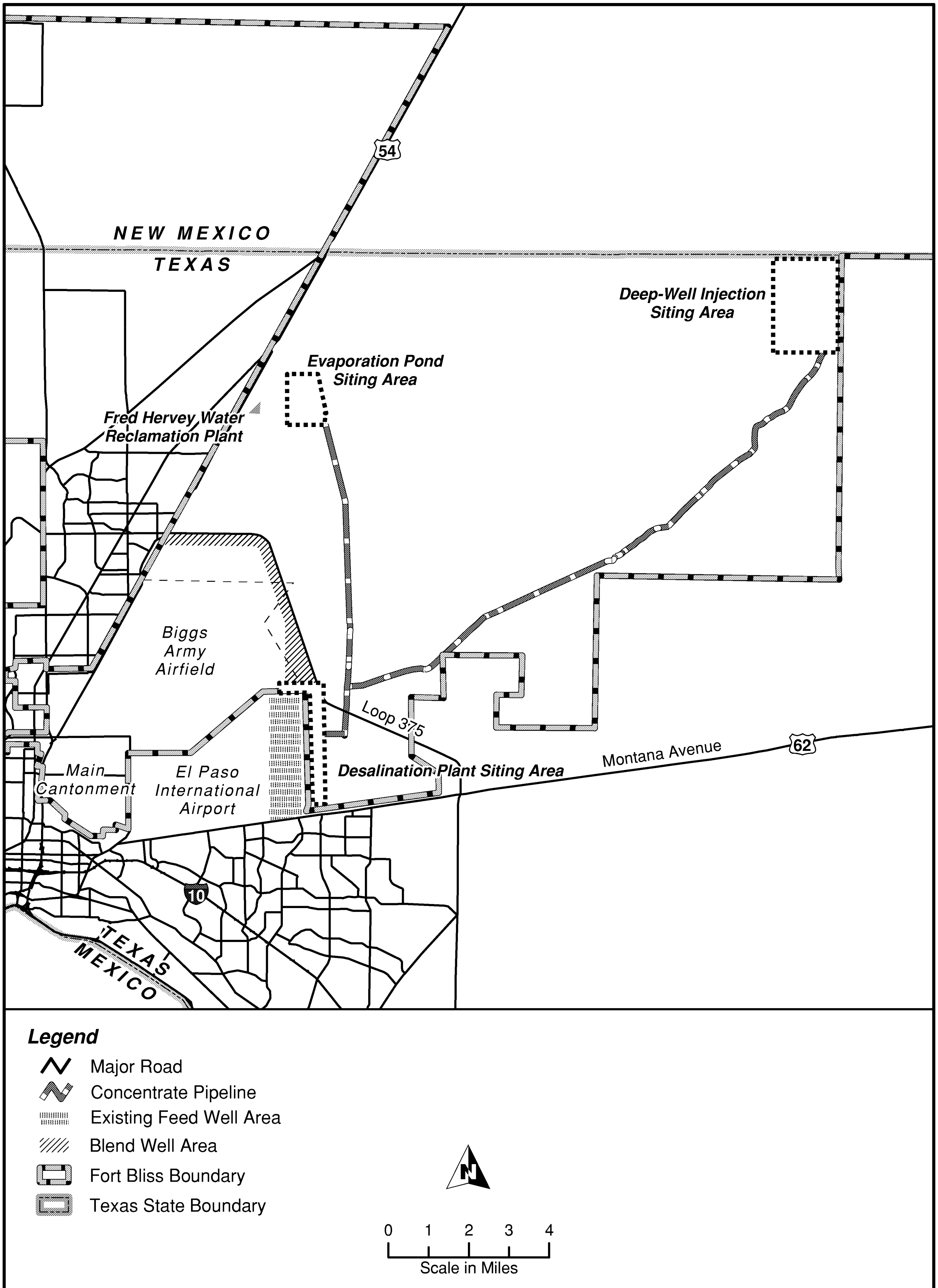


Figure 1-2. Locations of Proposed Desalination Facility, Associated Wells, and Concentrate Disposal Sites

The Fort Bliss Desalination EIS considers reasonable alternative sites on Fort Bliss for locating the above facilities, along with the alternative of not permitting the use of Fort Bliss land for the proposed project (the No Action Alternative). Other alternatives were evaluated by EPWU and determined to be not technically or economically practical or feasible. Alternatives not involving Army land or other resources are outside the scope of this EIS, including alternative locations for a desalination facility that would not include use of Fort Bliss property or resources. For the purposes of this document, those alternatives require no action on the part of the Army. The proposed desalination project is one of multiple activities EPWU plans to undertake to provide adequate water supplies for the City of El Paso. Other activities that do not involve any action or decision by the Army are also outside the scope of this EIS, except to the extent they could combine with the proposed action and alternatives to create cumulative impacts.

Chapter 2 describes the reasonable alternatives analyzed in detail in this EIS and other alternatives considered but eliminated from detailed analysis.

1.4 DECISIONS TO BE MADE

The Department of the Army, through the Commanding General of Fort Bliss will use the Fort Bliss Desalination EIS and public input on the findings of the EIS to make the following decisions:

- Whether to grant an easement to EPWU for construction and operation of a desalination plant and supporting facilities, including blend wells, on Army land in the South Training Areas of Fort Bliss, and, if so,
- Which alternative sites to allow EPWU to use for these facilities.

Granting an easement for the proposed project would include the right to pump blend water from Fort Bliss land. Construction of the proposed facilities and pumping of water from the proposed blend wells would result in disturbance and/or development of Army land, changes in groundwater underlying Fort Bliss land, and other environmental effects. The environmental impacts described in this EIS will be one consideration in the Army's Record of Decision. No decision will be made until the environmental impacts resulting from construction and operation of the proposed desalination plant have been reviewed by the Army, public comments have been considered, and implementation of the proposed action is found to be compatible with the installation mission.

Draft and final versions of this EIS are being made available to the public for review and comment before a decision is made. After the NEPA process has been completed, the Army's Record of Decision will be published in the *Federal Register*, and interested individuals and organizations will be notified of the decision.

1.5 RELATED ENVIRONMENTAL DOCUMENTS

This section describes the relationship between the Fort Bliss Desalination EIS and other relevant studies and environmental documents prepared to comply with NEPA.

The *Final Environmental Impact Statement, El Paso-Las Cruces Regional Sustainable Water Project* (RSWP EIS) prepared by the International Boundary and Water Commission (IBWC 2000) describes methods under consideration to provide an additional 175 MGD of water to communities in the El Paso–Las Cruces region of west Texas and southern New Mexico. The EIS evaluates the environmental impacts that could result from implementation of five action alternatives for increasing the regional supply of drinking water, along with a No Action Alternative. One of EPWU's objectives stated in the EIS is to extend the usable life of the Hueco Bolson Aquifer as a source of drinking water. The proposed desalination plant is one element of EPWU's long-range plan described in the EIS. Other actions include importing water and injecting treated surface water into the Hueco Bolson during periods of excess supply so the stored water can be used to meet drinking water demands during surface water shortages.

Desalination of brackish water from the Hueco Bolson is addressed in the RSWP EIS under “Cumulative Impacts.” One or more desalination plants are envisioned to supplement existing surface water supplies, protect fresh groundwater from encroachment of brackish water, and relieve drought conditions. The proposed desalination plant addressed in the Fort Bliss Desalination EIS would be one of those envisioned in the RSWP EIS.

The *Fort Bliss, Texas and New Mexico, Mission and Master Plan Final Programmatic Environmental Impact Statement* (PEIS) (U.S. Army 2000) evaluates the environmental impacts that could result from implementation of proposed changes in Fort Bliss missions, plans, facilities, and uses. It describes the affected environment in the South Training Areas where the desalination plant and supporting infrastructure are proposed. Much of the information presented in Chapter 3 of the Fort Bliss Desalination EIS was extracted from the Mission and Master Plan PEIS.

The Texas Department of Transportation (TxDOT), in cooperation with the New Mexico Department of Transportation, conducted the *Northeast Parkway Route Location Study* to examine the feasibility of establishing an alternative route to the congested Interstate 10 corridor through El Paso for through truck and other traffic. The study began in February 2002 and concluded in August 2003. Initially, the route location study identified seven alternatives, including No-Build and Transportation System Management options.

Following public and agency input and an analysis of environmental, cost and technical constraints and opportunities, a 22-mile long, limited access highway connecting Loop 375 in northeast El Paso near Railroad Drive to I-10 was selected as the preferred alignment option. It was recognized, however, that detailed environmental and technical studies to be performed during the schematic/environmental phase of project development might alter alignments slightly or mix segments of one alignment with those of another. That phase is expected to be concluded by November 2006.

The resulting actions could alter traffic patterns in the project area for the proposed desalination plant. No schedule for construction of the limited access highway is currently available.

1.6 PUBLIC INVOLVEMENT

NEPA and CEQ regulations require that the public potentially affected by a major federal action be given an opportunity to, first, provide input on the scope of the EIS analyzing the action and, second, review and comment on the findings of the Draft EIS. This section describes the public involvement activities undertaken to provide opportunity for public input into the Fort Bliss Desalination EIS.

1.6.1 Public Scoping

As a preliminary step in the development of an EIS, CEQ and Army regulations require an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action. The purpose of the scoping process is to: (1) inform the public about the proposed action and the alternatives being considered, and (2) identify and clarify environmental issues that are relevant to the EIS by soliciting public comments.

On September 12, 2003, the Army published a Notice of Intent in the *Federal Register* (68 FR 53724, September 12, 2003) to prepare the Fort Bliss Desalination EIS. Notices were also published in the Sunday editions of The El Paso Times on September 27, 2003 and October 4, 2003. Public service announcements were aired on regional radio and television stations. In the Notice of Intent, the Army invited public comment on the proposed desalination plant, the range of alternatives to be evaluated, and environmental concerns attendant to the construction and operation of the proposed desalination plant.

A public scoping meeting on the Fort Bliss Desalination EIS was held on October 9, 2003 at Ysleta Independent School District administrative offices in El Paso, Texas. Public citizens, civic leaders, and other interested organizations and individuals were invited to comment on the environmental issues surrounding construction and operation of the proposed desalination plant. The meeting began with a presentation by Army representatives who described the proposed desalination plant and its supporting infrastructure, explained the proposed action and alternatives, and reviewed the EIS process and schedule. Displays and fact sheets were available to provide information about the project. Army representatives were available to respond to questions during an informal poster session held before and after the presentation. Then the floor was opened to comments from attendees. Comments were solicited in both English and Spanish, and an interpreter was available to translate Spanish comments into English. Two individuals provided oral comments. The proceedings were recorded verbatim by a court reporter.

Attendees were also encouraged to submit written comments on forms provided at the meeting, or to submit comments by letter or fax during the scoping period that ended on October 26, 2003. Two written comments were received during this period. The Army considered all comments received during the scoping period in preparing the Fort Bliss Desalination EIS. The comments and their disposition in the EIS are listed in **Table 1-1**.

The oral and written comments were reviewed to determine whether or not they were (1) substantive and (2) relevant to the scope of the EIS, as defined by the purpose of and need for the proposed action. Guidelines used for determining if a comment was substantive were based on the criteria from the CEQ regulations (40 CFR 1503.4[a]). Comments were considered substantive if they included:

- A suggestion to modify the proposed action or any of the alternatives;
- A proposal to develop and evaluate new alternatives;
- Input on the environmental topics or issues to be analyzed in the EIS; or
- A suggestion on how to conduct the analyses.

Comments were considered within the scope of analysis if they related to the Army's decision concerning granting of an easement on Fort Bliss land to the City of El Paso for the purpose of constructing and operating a desalination facility and supporting infrastructure.

Table 1-1. Scoping Comments

Comment	Disposition
A representative of U.S. Senator Cornyn stated the Senator would support whatever the people of El Paso wish.	No action required in the EIS.
A representative of the El Paso Group of the Sierra Club and West Texas Water Protection Fund expressed general support for desalination but requested that the city explore other alternatives for disposing of the concentrate, such as putting it to beneficial use.	Determined not to be a reasonable alternative (see Section 2.6).
A local rancher requested that deep-well injection be removed from consideration as a means of disposing of the concentrate due to the proposed deep well injection site being 3 miles from his property and 7 miles from one of his active water wells.	The EIS addresses the potential for deep-well injection of concentrate to contaminate water wells located in the vicinity of the proposed injection site.

Table 1-1. Scoping Comments

Comment	Disposition
A commenter questioned the feasibility of both deep-well injection and evaporation ponds as disposal alternatives for the concentrate, citing the cost of permitting associated with deep-well injection and public acceptance, odor, and potential leaking as issues associated with the evaporation ponds. The comments further questioned the appropriateness of continuing to "mine" water from the non-rechargeable Hueco Bolson. The commenter requested that the EIS consider an alternative of importing water from a desalination facility in Dell Valley.	The possibility of importing water from a desalination facility in Dell City and piping the water to El Paso is being considered by EPWU as an additional water source, but not as an alternative to the development of a facility on Fort Bliss. This proposal is not yet adequately defined to analyze the environmental impacts in detail at this time. It could be considered by EPWU in the future as a supplement to the Fort Bliss desalination plant, or if this EIS results in selection of the No Action Alternative. EPWU has projected that as much as $500 million will be spent in the coming decade to import water from counties east of El Paso. The potential for development of other desalination plants is discussed in this EIS under the No Action Alternative and in Cumulative Impacts. The EIS addresses the comments concerning odor, potential for contamination, and depletion of the Hueco Bolson Aquifer.

1.7 REGULATORY AND PERMIT REQUIREMENTS

Construction and operation of the proposed desalination project would have to comply with Texas Commission on Environmental Quality (TCEQ) and other regulatory and permit requirements listed in **Table 1-2**. Additional easement conditions and mitigation measures may be required by the Army to avoid or reduce adverse environmental or mission impacts.

Table 1-2. Summary of Regulatory and Permit Requirements

Action/Location	Requirement	Legislation	Agency
Plant Construction	Public Water Supply Notification	TAC §290.39	TCEQ Water Supply Division
Brine Disposal	Permit on case-by-case basis	Dependent on brine disposal method	TCEQ Water Quality Division
Existing Well Use	No action required, permits already in place	TAC §290 Subchapter D	TCEQ Utilities & Districts Section
New Well Construction	Authorization from Plan Review Team	TAC §290 Subchapter D	TCEQ Utilities & Districts Section

CFR = Code of Federal Regulations
TAC = Texas Administrative Code
TCEQ = Texas Commission on Environmental Quality
USC = United States Code
USEPA = Environmental Protection Agency

Source: MCi/CDM 2003

2 ALTERNATIVES CONSIDERED INCLUDING THE PROPOSED ACTION AND NO ACTION ALTERNATIVE

This chapter describes the desalination project proposed by EPWU to be constructed and operated on Fort Bliss land. It outlines the main components of the project, explains the desalination process, and provides details about the project for analysis of its environmental impacts in Chapter 4. It then describes the alternatives being considered by the Army in making the decisions listed in Chapter 1. This includes six action alternatives for providing use of Fort Bliss land to the EPWU and the No Action Alternative. The six action alternatives comprise a combination of three alternative sites for the desalination plant and two disposal methods for concentrate from the desalination process. The chapter explains the process and criteria used to identify these reasonable alternatives, and summarizes the alternatives eliminated from detailed study.

Chapter 2 also describes how the use of Fort Bliss land for the proposed desalination plant and supporting facilities relates to the Fort Bliss military mission. It compares the environmental consequences of the alternatives analyzed in detail and identifies mitigation measures and monitoring procedures to reduce adverse environmental impacts from the proposal.

2.1 PROPOSED ACTION

EPWU has submitted an application to the Army for land to construct and operate a desalination plant and supporting facilities within the South Training Areas of Fort Bliss. This section describes the facilities and operations that EPWU proposes to conduct on this land.

The desalination plant would treat brackish water drawn from the Hueco Bolson, called “feed” water, using a technology called reverse osmosis (RO). RO uses semipermeable membranes to remove dissolved solids (primarily salts) from brackish water, producing freshwater. When brackish water is forced across appropriate membranes under pressure, the membranes act as a filter or barrier which retains most of the dissolved solids while allowing most of the water to pass through (**Figure 2-1**). The result is two water streams: a fresh water stream (the **permeate**) and a concentrated brackish water stream (the **concentrate**). The permeate would be very pure, whereas drinking water contains some minerals, including salt. Therefore, the permeate would be mixed with brackish “**blend**” water, also drawn from the Hueco Bolson, prior to distribution in the public water supply. This procedure would also increase the volume of water output from the desalination plant. The blended water is called “**finished**” water.

The finished water from the plant would comply with federal and state drinking water standards and be suitable for use as drinking water. The concentrate would have high total dissolved solids (TDS) content (primarily salt and other minerals that occur in the feed water), more than 5,000 milligrams per liter (mg/l), and would require disposal. The plant is anticipated to provide approximately 27.5 MGD of finished water and produce approximately 3 MGD of concentrate. The exact amount of permeate and concentrate would depend on a number of factors, including how brackish the feed water is and the efficiency of the RO process. The sections below provide additional detail about the desalination process.

Reverse Osmosis

The proposed desalination plant would use **Reverse Osmosis** to obtain drinkable water from brackish water drawn from the Heuco Bolson Aquifer. The process is called Reverse Osmosis because it reverses the natural flow of water that occurs in Osmosis. Figures below illustrate Osmosis and Reverse Osmosis.

Osmosis: If water with a low concentration of contaminants is separated from water with a higher concentration of contaminants by a semi-permeable membrane, then water will flow through the semi-permeable membrane toward the side with the higher concentration of contaminants. The membrane is called "semi-permeable" because water can flow through the membrane but most contaminants cannot. Water will tend to flow through in the direction shown until the concentration of contaminants is the same on both sides of the membrane.

Reverse Osmosis: In reverse Osmosis, pressure applied to the side of the container with the higher contaminant concentration forces water to flow toward the side with the lower contaminant concentration. Water then flows the opposite direction from that shown for osmosis.

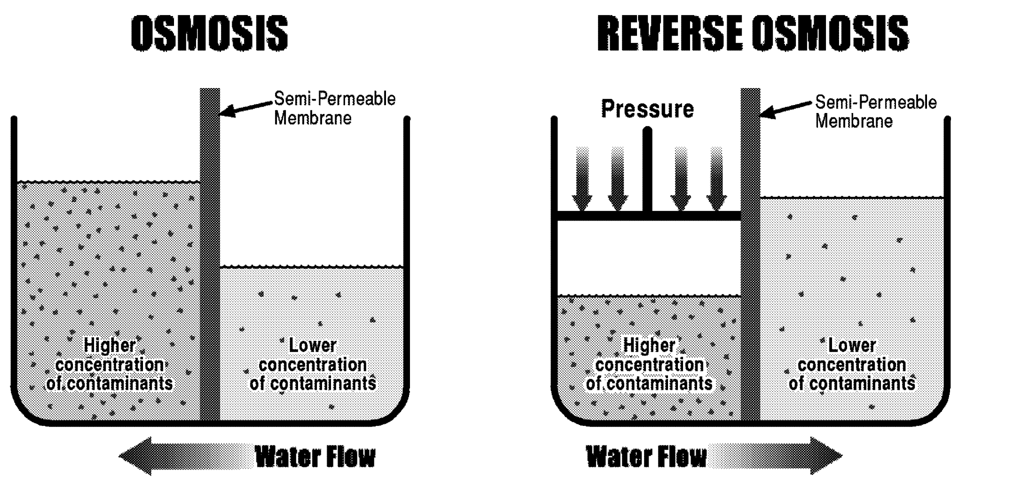


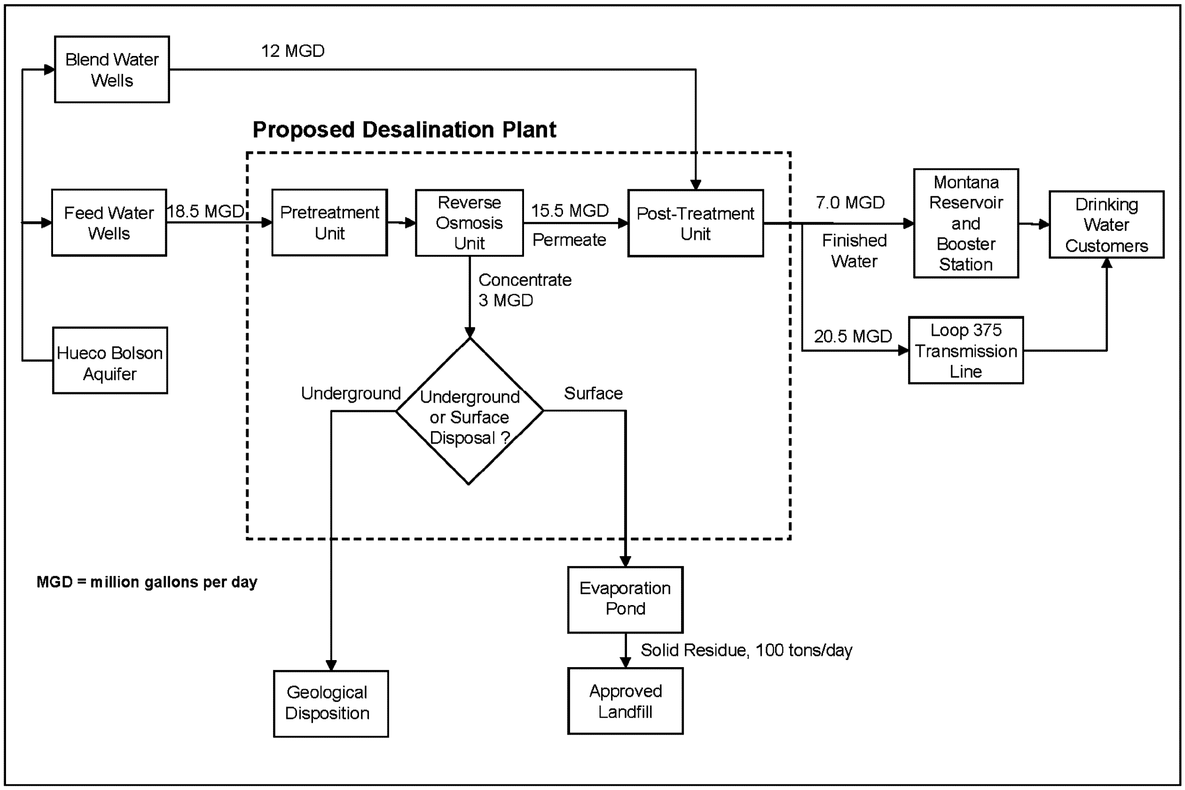
Figure 2-1. Reverse Osmosis Process

2.1.1 Project Components

Figure 2-2 illustrates the main elements of the desalination process. The process would begin with withdrawal of brackish feed water from existing wells near EPIA. That water would be treated in the proposed desalination plant to remove the dissolved solids (primarily salts) and produce the permeate. Water would also be withdrawn from new blend wells north of the facility along Loop 375 and mixed with the permeate at the desalination plant. The resulting finished water would be pumped to the existing water line along Loop 375, and a portion of it would flow by gravity to the Montana Reservoir and Booster Station. The concentrate rejected by the RO unit would be pumped out of the desalination plant and disposed of underground through deep-well injection, or on the surface in evaporation ponds with ultimate disposal of residual solids in an approved landfill. The following sections describe the activities that would occur at the desalination plant site and at the concentrate disposal site.

2.1.1.1 Desalination Plant

Figure 2-3 shows the site plan for the proposed desalination plant. An entry road from the street would lead to an administration building, the Learning Center, and a 120-vehicle parking lot. The Learning Center would be used to train EPWU employees, provide exhibits on water issues in a desert environment, and offer a location for conventions and public education. Treatment of the feed water would occur in the process building, the largest of the buildings on the site. Several much smaller supporting buildings would include a chemical containment structure, a finishing chemical storage structure, a clearwell and pump station, a feed water strainer facility, feed water meter vaults, a concentrate pump station, and electrical transformers. A ponding area would be used to handle start-up flows and then for site drainage. Site security would include security fencing that meets force protection standards, an entry checkpoint, building security, closed circuit television, and a coded photo identification badge system. Access to the process building would be provided through an entry checkpoint in the administration building.



Note: All numbers are approximate.

Figure 2-2. Process Flow for the Proposed Desalination Project

The design of the plant would incorporate sustainability principles to reduce energy consumption and pollutant emissions. These would include measures such as use of energy-efficient motors, energy recovery turbines, energy-efficient glass to minimize lighting/heating/cooling costs, and installation of water efficient systems such as waterless urinals.

For analysis purposes, the projected life span of the plant could be up to 50 years, but treatment methods and the quality of the feed water would require evaluation throughout the life of the project for possible operating changes to the plant.

As illustrated in Figure 2-2, the treatment process conducted in the desalination plant would include the following activities:

- Pretreatment of feed water drawn from existing airport wells;
- Purification of the feed water in the RO unit; and
- Post-treatment of the combined permeate and blend water prior to distribution.

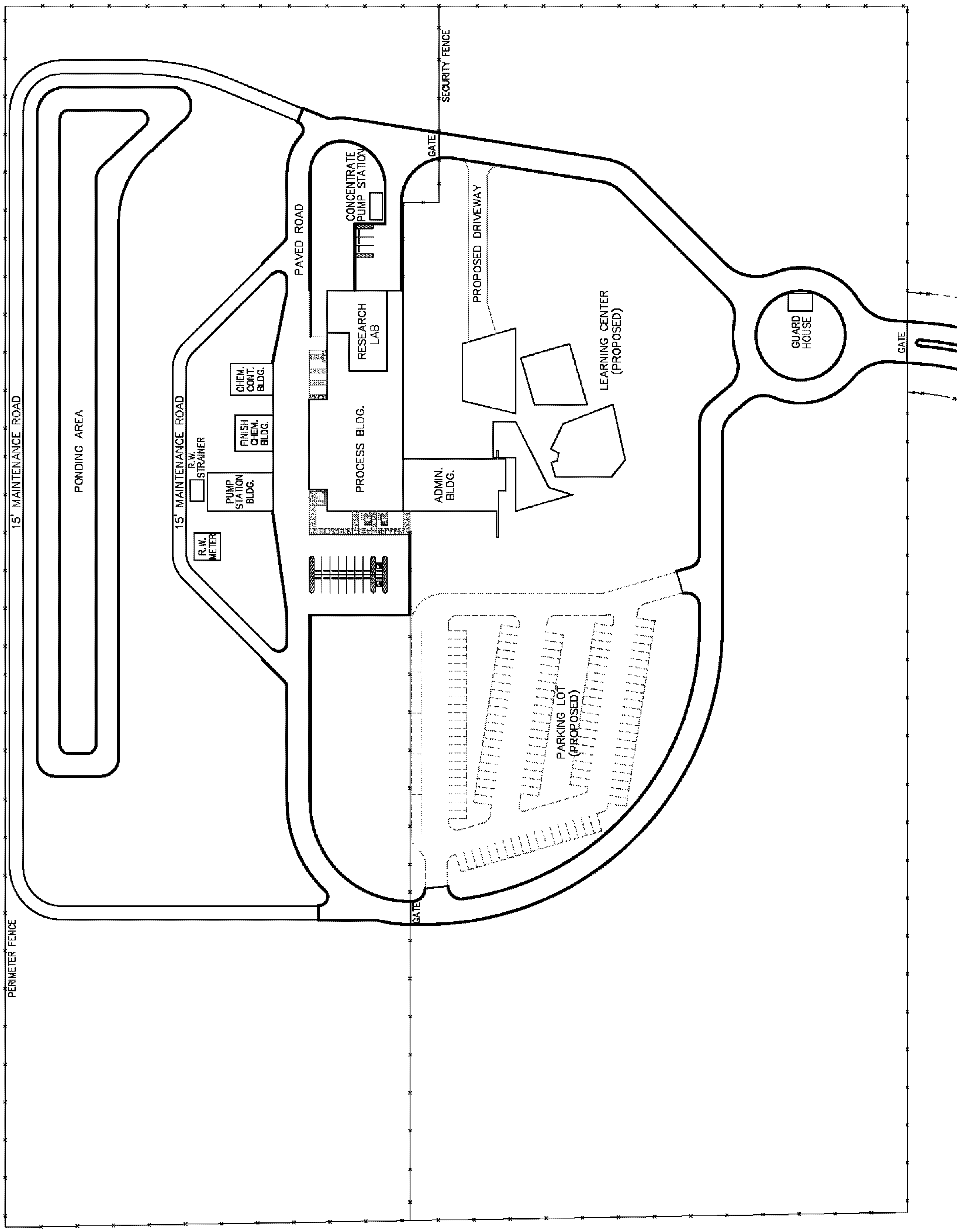


Figure 2-3. Proposed Site Plan for the Desalination Plant

The subsections below discuss each step in the process.

Pre-Treatment

Water would be pumped from the feed and blend wells to the desalination plant through 5.4- to 8.1-mile, high-density polyethylene (HDPE) and/or polyvinyl chloride (PVC) pipes of varying diameters ranging from 12 to 42 inches. The pretreatment unit would prepare the feed water for processing in the RO unit. The objective of pretreatment would be to remove large particles and inhibit fouling (accumulation of minerals, algae, or bacteria), wear, and damage to the membranes in the RO unit.

First, a sand strainer would be used to remove any small-grained sand. A commercially available anti-scalant such as Pretreat Plus™ Y2K would be injected into the feed water to achieve a concentration of 5 mg/l. The anti-scalant would inhibit fouling of the RO membranes by minerals such as silica, iron, barium, carbonate, and calcium sulfate.

Pretreat Plus™ Y2K is a proprietary formulation composed of phosphoric acid and related phosphonic acids (King Lee Technologies 2000). According to the Material Safety Data Sheet for the product, none of the ingredients have listed occupational exposure values and can be considered generally safe if handled with due care. After treatment in the RO unit, the concentrate would contain 27 mg/l of the Pretreat Plus™ Y2K (Trzcinski 2004a).

The proposed plant would store a 15-day supply of the anti-scalant in a 6,000-gallon tank. The storage tank would be surrounded by secondary containment walls sized to hold 110 percent of the volume of the tank.

Dilute sulfuric acid would also be added to the feed water to reduce its pH prior to entering the RO unit. The sulfuric acid would convert carbonate and bicarbonate in the feed water to carbonic acid, reducing the potential for the formation of calcium carbonate scale inside the membrane feed channels and on membrane surfaces. Undiluted sulfuric acid with a concentration of 93 percent would be stored in a 6,000-gallon tank, which would contain sufficient supply to adjust the pH of feed water from 8.2 to approximately 7.0 for 15 days at maximum production. The storage tank would be surrounded by secondary containment walls sized to hold 110 percent of the volume of the tank. The sulfuric acid would only be added when the pH of the feed water needs to be adjusted.

After these chemicals have been added, the feed water would be filtered through cartridge filters, which would remove materials in the water having a diameter larger than 5 microns (0.00004 inches). These filters would remove silt, grit, and sand to prevent damage to the RO membranes. The pretreated, filtered, feed water would then go to the RO unit.

Reverse Osmosis Unit

The RO process currently envisioned for the proposed desalination plant would be a two-stage process. Each stage would produce permeate and concentrate. The concentrate from the first stage would become feed water for the second stage of RO purification. The concentrate from the second stage treatment would be sent to disposal. The permeate from both stages would be combined. The total volume of permeate is expected to be 80 percent or more of the volume of the feed water — for each 100 gallons of feed water entering the RO process, approximately 80-85 gallons of permeate would be obtained, and 20 gallons or less of concentrate would be produced.

As currently designed, the RO process would occur in five RO modules that treat about 3 MGD each. Each module would contain 48 pressure vessels in the first stage and 24 pressure vessels in the second stage. Each pressure vessel would contain seven RO membranes, for a total of 2,520 membranes. Each RO membrane would be 8 inches in diameter and 40 inches long.

The proposed desalination plant would use thin-film composite membranes. Thin-film composite membranes consist of thin layers of dissimilar materials that are joined together to form a single membrane. The various layers are selected to optimize membrane productivity, performance, and durability.

During operation, flow and pressure drop across the membranes and TDS concentration in the permeate would be monitored. Changes in any of these values would indicate possible membrane fouling. A cleaning system would address any fouling that cannot be completely controlled by pretreatment. The cleaning system would use various chemicals, depending on the nature of the problem. Cleaning chemicals such as acids, bases, enzymes (organic chemicals that break down molecules), biocides (chemicals that kill algae or bacteria), oxidants (inorganic chemicals that can destroy certain organic molecules and organisms), chelating agents (chemicals that remove dissolved molecules from solution), and detergents would target the cause of the fouling. The cleaning solutions would be discharged to the sanitary sewer following use and would not become part of the concentrate or finished water. Membranes being cleaned would be taken off line and would not contribute to the desalination process during cleaning.

The modules would need to be cleaned after approximately 4,000 to 8,000 hours of operation. Only one module would be cleaned at a time, and cleaning would take approximately two days per module.

It is possible that not all of the modules would need to be in operation during winter months when water demand lessens, or at other times of varying production demands. A module must be flushed with permeate when it is not in operation to prevent fouling. Permeate would be stored in cleaning system tanks for this purpose, and the cleaning system would be used to flush the membrane modules with the permeate. After flushing, the water would be routed to the wastewater pumping station and disposed of in the sanitary sewer.

Appendix A provides more detailed information about the RO process.

Post Treatment

During post treatment, the permeate would be mixed with blend well water and treated to adjust pH. The permeate would enter the clear well, a large in-ground concrete tank, where it would be mixed with blend well water, and the pH would be adjusted with a sodium hydroxide solution (caustic soda). The maximum feed rate would be 15 mg/l, with an average feed rate of 10 mg/l. The caustic soda would be stored in a 50 percent solution in a 10,000-gallon tank. Caustic soda at this strength is susceptible to freezing at 55 degrees Fahrenheit (ºF), requiring a controlled environment.

The water would be disinfected by adding a 10–15 percent solution of sodium hypochlorite. The maximum sodium hypochlorite dosage rate would be 2.5 mg/l. This equates to approximately 25 gallons per hour treating 27.5 MGD with a 12.5 percent sodium hypochlorite solution.

The sodium hydroxide solution and the sodium hypochlorite solution would each be stored in 10,000-gallon tanks located in a separate, enclosed, environmentally controlled building, just north of the main process building (see Figure 2-3). The building would have a secondary containment structure capable of holding 150 percent of the volume of each tank.

A corrosion inhibitor, such as sodium hexametaphosphate, would be added to the clearwell to prevent leaching of lead, copper, zinc, or iron from pipes. The corrosion inhibitor would be stored in a 6,000-gallon tank with a concrete secondary containment basin to contain the chemical in the event of leak or tank failure. The type and quantity of corrosion inhibitor to be used, if any, would be determined through testing of the finished water. All chemicals to prevent pipe corrosion would be incorporated into the finished water and would have to meet state and federal drinking water standards.

A pump station would convey a portion of the finished water directly to the distribution system, while the remaining finished water would be conveyed by gravity to the existing Montana Reservoir and Booster Station pump station complex.

2.1.1.2 Feed Wells and Blend Wells

The water that would be treated in the proposed desalination plant would be drawn from the Hueco Bolson using 15 existing feed wells and 16 new blend wells. The existing EPWU feeds wells will be rehabilitated to clean and repair the casing, well screen, and piping and install new pumps, valves, and instrumentation (EPWU-PSB 2004). Approximately 18.5 MGD would be furnished by the feed wells.

The blend wells would be standard well construction. The well depths would be approximately 900–925 feet. Each well would be drilled to a diameter of 26 inches, lined with a 16-inch diameter casing, and backfilled with gravel (EPWU 2004). Together, they would furnish an estimated 12 MGD for the desalination plant.

EPWU plans to pump about the same quantity of water from the Hueco Bolson under all the alternatives, including No Action: 40,000 acre-feet (AF) per year in normal river flow years, and 75,000 AF/year in years with below normal river flow. This water would be pumped from a combination of existing EPWU wells and the new blend wells. As more water is pumped from the feed wells and blend wells, EPWU's plan is to reduce proportionately the quantity of fresh water pumped from other wells. Periods of unusually severe drought may require increases in pumpage to make up any shortfalls.

2.1.1.3 Concentrate Disposal

The proposed desalination plant is expected to produce approximately 3 MGD of concentrate. Concentrate from the RO process would be piped to a pump station on the desalination plant site (see Figure 2-3). From there, it would be pumped to the disposal site through underground pipes. Two alternatives methods for concentrate disposal are evaluated in this EIS: (1) injection of concentrate deep underground and (2) evaporation in surface ponds followed by disposal of the residual solids in an appropriate landfill. The following sections provide an overview of each method. More detailed information is contained in **Appendix B**.

Underground Disposal Through Deep-Well Injection

Under this alternative disposal method, the concentrate would be pumped from the proposed desalination plant through an underground pipeline to a deep-well injection site. There, it would be pumped to an underground formation comprised of porous rocks more than 2,000 feet below the ground surface. **Figure 2-4** illustrates a typical deep-well injection installation. The underground formation into which the concentrate would be injected, the injection zone, must be large enough to contain the projected quantity of concentrate over the life of the project, and it must be isolated from other aquifers that provide a source of potable water.

Concentrate disposal by this method would be required to meet Underground Injection Control (UIC) permitting standards adopted by the TCEQ. These standards, which are described in **Appendix C**, are intended to ensure that injected concentrate is isolated from fresh water supplies.

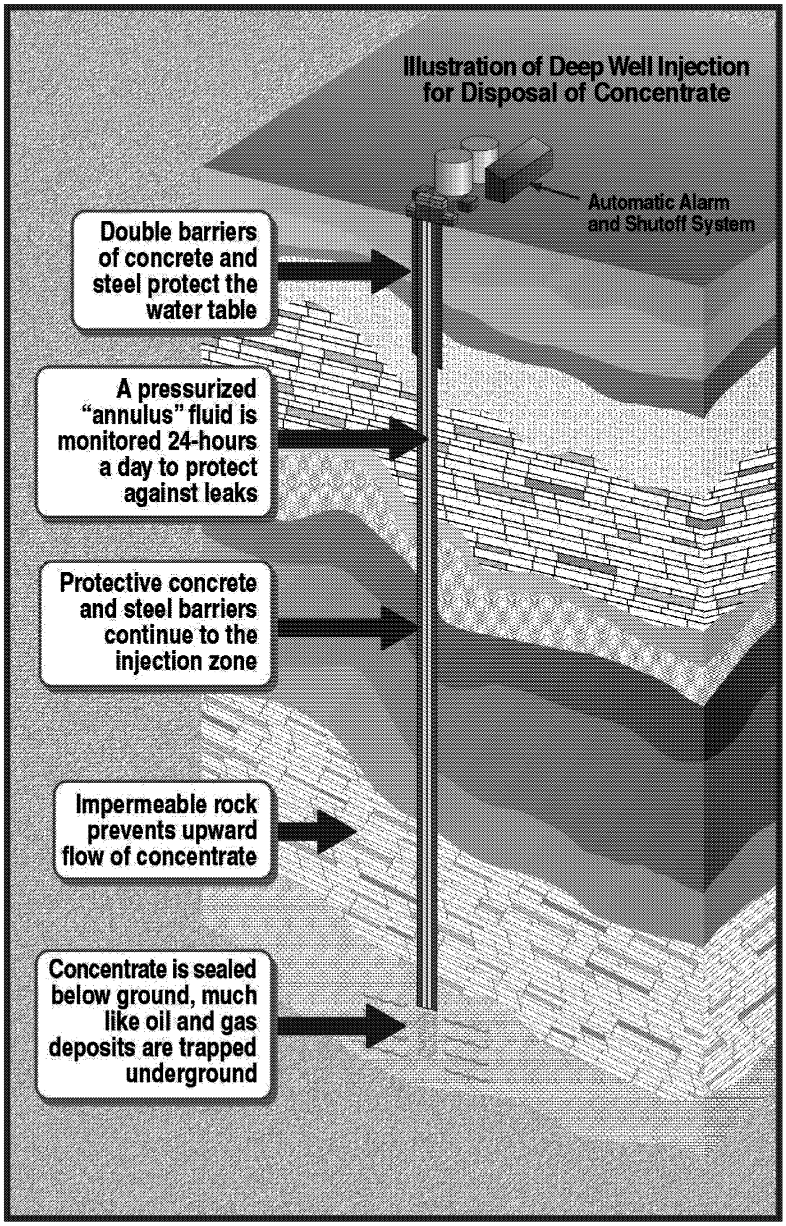


Figure 2-4. Schematic Diagram of Typical Deep-Well Injection Installation

A decision has not yet been made as to whether concentrate injection would require a permit for a Class I (hazardous waste; industrial non-hazardous waste injected below an underground source of drinking water [USDW]) or Class V (non-hazardous waste injected into or above an underground source of drinking water). The pilot well is being constructed to Class I standards. In general, TCEQ rules for Class I wells require:

1. A demonstration of the integrity of the well, to ensure that injected waste is only injected into the target formation and not into formations above the target formation. This is a requirement for the duration of injection operations.

2. Operation to prevent the movement of fluids that could result in pollution of a USDW and to prevent leaks from the well into unauthorized zones.

3. A demonstration of the compatibility of injected waste (concentrate) with fluids and minerals in the injection zone and materials used to construct the well. Brackish water would be added to the concentrate, if necessary, to reduce the TDS to levels comparable to the water in the injection zone.

Periodic monitoring and reporting requirements are imposed on all UIC permit holders to ensure that the integrity of the injection well is maintained over the lifetime of the facility and that migration of the concentrate to nearby USDWs has not occurred.

Surface Disposal Using Evaporation Ponds

The second alternative method for disposing of the concentrate from the RO process would use evaporation ponds to remove the remaining water, leaving residual solids composed of salt and other minerals that naturally occur in the feed water. The residual solids would be transported by truck to a landfill for final disposal. The concentrate would be pumped from the concentrate pump station at the desalination plant site through underground pipeline to new evaporation ponds located adjacent to the existing Fred Hervey Water Reclamation Plant (FHWRP).

The projected size of the ponds (covering 680.5 acres) is based on an EPWU analysis of the volume of concentrate (3 MGD) and monthly patterns of rainfall and evaporation. **Figure 2-5** illustrates a typical cross-section of an evaporation pond. All ponds would be approximately 5 feet deep, with approximately 3 feet of freeboard (i.e., containment dikes would be 3 feet above the operational water level in the pond). Concentrate would be pumped into four large ponds (128 to 134 acres each), which would never be dry. The large ponds would have the capacity to hold approximately 280 days of concentrate. After holding in the large ponds for varying periods of time (depending on rainfall and evaporation rates), the concentrate would be pumped into one of eight smaller management ponds (20 acres each). When a management pond fills up, flows to that pond would be shut off and diverted to another small management pond, and so on. The water in the filled management pond would then evaporate, leaving the solids that would be removed and trucked to the landfill.

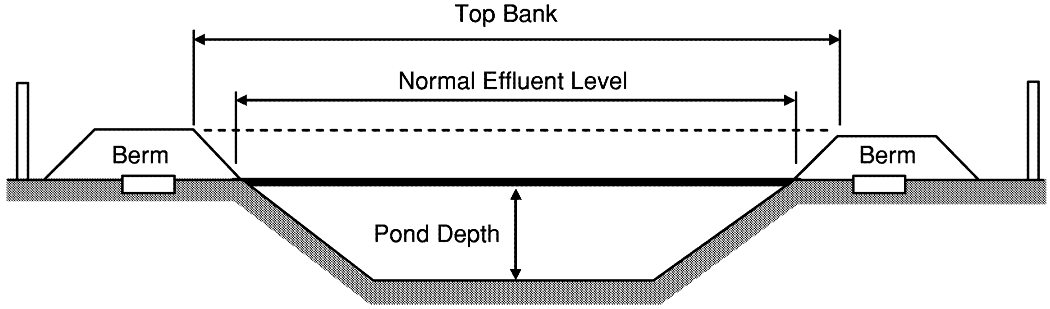


Figure 2-5. Typical Evaporation Pond Profile

At the influent to the pond, the concentrate would have an estimated TDS concentration between 6,500 and 10,200 mg/l, depending on the TDS concentration of the feed water (which would increase over time) and the efficiency of the RO process. As water evaporates from the concentrate, TDS concentrations will increase.

The disposal of waste via evaporation requires a wastewater permit, commonly called a Texas Land Application Permit. There are two basic concerns with these permits if there is to be no discharge to surface water or irrigation use: sizing of the ponds and lining of the ponds. For industrial permits, rules found at 30 TAC Chapter 309 (see **Appendix D**), Domestic Wastewater Effluent Limitation and Plant Siting are applied by TCEQ using best professional judgment (Wilson 2004).

To meet TCEQ permitting requirements, all evaporation ponds must be lined and meet one of the following three criteria:

1. Soil Liner. The soil liner shall contain at least 3 feet of clay-rich (liquid limit greater than or equal to 30 and plasticity index greater than or equal to 15) soil material along the sides and bottom of the pond compacted in lifts of no more than 9 inches, to 95 percent standard proctor density at the optimum moisture content to achieve a permeability equal to or less than 1 x 10^{-7} (0.000001) cm/sec.

2. Plastic/Rubber Liner. The liner shall be either a plastic or rubber membrane liner at least 30 mils in thickness which completely covers the sides and the bottom of the pond and which is not subject to degradation due to reaction with wastewater (concentrate) with which it will come into contact. If this lining material is vulnerable to ozone or ultraviolet deterioration, it should be covered with a protective layer of soil of at least 6 inches. A leak detection system is also required.

3. Alternate Liner. The permittee shall submit plans for any other pond lining method. Pond liner plans must be approved in writing by the Executive Director of the Texas Commission on Environmental Quality prior to pond construction.

In addition, groundwater monitoring would be required to allow early detection and repair of liner leaks.

A key part of the evaporation pond alternative is the disposal of the resulting solids. Between 72 and 111 tons of solids would be generated per day, with lower amounts in early stages of the project (Trzcinski 2004b). Disposal in a landfill, as currently planned, requires that the solids not be classified as a hazardous waste. Under the Resource Conservation and Recovery Act (RCRA), a hazardous waste may be specifically listed as or have a characteristic of a hazardous waste. The solid is not a listed hazardous waste, and there are four characteristics that determine whether the waste would be hazardous: (1) ignitability, (2) corrosivity, (3) toxicity, and (4) reactivity. It is not expected that the solid would have any of these characteristics. **Table 2-1** presents anticipated chemical concentrations in the concentrate and the residual solid, based on data taken on the feed wells since 1990. The waste would be characterized as toxic if any of the components listed had a maximum concentration of a Toxicity Characteristic Leaching Procedure (TCLP) leachate greater than allowable regulatory levels. None of the expected concentrations in the leachate would exceed regulatory levels, so the solid would likely be able to be disposed of in a solid waste landfill.

Table 2-1. Projected Chemical Concentrations of TCLP Chemicals in Concentrate, Residual Solid, and Solid Extract

Chemical	Concentration in Concentrate (mg/l)[a]	Concentration in Residual Solid (mg/kg)[b]	Maximum Concentration in TCLP Extract (mg/l)[c]	Maximum Allowable Concentration for Non-Hazardous Waste (mg/l)[d]
Arsenic	0.0485	7.47	0.37	5.0
Barium	1.1830	182.00	9.10	100.0
Cadmium	0.0047	0.72	0.04	1.0
Chromium	0.0339	5.21	0.26	5.0
Lead	0.0272	4.18	0.21	5.0
Mercury	0.0030	0.45	0.02	0.2
Selenium	0.0344	5.29	0.26	1.0
Silver	0.0109	1.68	0.08	5.0

a. Estimated concentration based on the weighted mean of data on the chemical composition of water taken from 14 feed wells between 1990 and the present and assuming 83% efficiency of RO process. Non-detected values are included at 1/2 the detection level.

b. Estimated concentration in residual solid remaining after concentrate evaporation, based on the projected volume of concentrate using an estimated TDS of 6,500 mg/l.

c. Maximum possible concentration in leachate of TCLP test, calculated by SAIC based on estimated concentration in residual solids.

d. Maximum concentration allowable for a non-hazardous waste, 40 CFR 261.24.

TCLP – Toxic Characteristic Leaching Procedure tests the concentrate of chemicals that could leach out of a solid waste exposed to water.

Source: Adapted from CDM 2004

Concentrate Disposal Pipeline

The pipes used to convey the concentrate across the South Training Areas would be designed and constructed to withstand the pressure of any vehicles and equipment that might be used by the Army in training. The heaviest load is expected to be an M1A2 tank on a carrier. M1A2 tanks have a weight of 70 tons and ground pressure (off the carrier) of 15.4 pounds per square inch (Klaes 2004a). HDPE and/or PVC piping would be used because of its inherent corrosion resistant properties and ease of installation. A secondary advantage of HDPE pipe is that it is a cost effective choice for long buried runs. EPWU plans to use Cooper E80 train loading to simulate the maximum pressure the pipeline could experience from military training equipment. The depth and piping wall thickness would be defined at final design to prevent breakage from military training with heavy armored vehicles. Currently, EPWU anticipates the depth of the pipeline would be at least five feet, with a cover of compacted fill.

There would be no above ground structures or buildings along the pipeline between the plant site and the disposal site. Isolation valves would be located along the length of the pipeline at various intervals approximating 3,000 feet. Valve actuators/operators would be housed in a 2.5-foot-square concrete reinforced valve vault with a concrete reinforced lid designed to withstand military equipment loads. The top of the lid would be slightly below grade and thus would not protrude above ground. Another option would be to span the valves with buried reinforced concrete. The valves would be tied into the EPWU Geographic Information System and easily located by EPWU field personnel using Global Positioning

System. Flow/pressure sensing instrumentation at the desalination plant control room would detect any leaks along the pipeline. The pumps for the concentrate pipeline would be located at the desalination plant site. It is not expected that additional pumps would be needed along the pipeline. If a leak were detected by the automatic leak detection system, an alarm would sound in the EPWU Central Control, which would be manned 24 hours a day, and a field crew would be immediately dispatched to locate and isolated the leak. The pump would be manually shut off to repair the pipe damage.

Pigging stations (locations where pipes can be accessed for maintenance) with above-grade piping would be located within the plant site and at the deep well injection site. Those two locations would handle maintenance for the entire length of the concentrate pipeline. Intermediate pigging stations are not anticipated to be needed.

2.2 ALTERNATIVES ANALYZED IN DETAIL

Subsequent to completion of the NEPA process, the Army will select one of seven alternatives analyzed in detail in this EIS: six action alternatives that would involve implementation of the proposed desalination project on Fort Bliss land and the No Action Alternative. The following sections describe these alternatives.

2.2.1 Action Alternatives

This EIS analyzes the six action alternatives listed in **Table 2-2**. They include various combinations of three potential sites for the proposed desalination plant and two methods of disposal of the concentrate that results from the desalination process. The location of each of these sites is shown on **Figure 2-6**.

Table 2-2. Summary of the Action Alternatives

Action Alternative	Desalination Plant Location [a]	Method for Concentrate Disposal
1	Site 1	Deep-well injection
2	Site 2	Deep-well injection
3	Site 3	Deep-well injection
4	Site 1	Evaporation ponds
5	Site 2	Evaporation ponds
6	Site 3	Evaporation ponds

[a] See Figure 2-6

All of the alternative sites under consideration are located in the South Training Areas of Fort Bliss. The South Training Areas comprise seven Training Areas (TAs): 1A and B and 2 A, B, C, D, and E. As Figure 2-6 shows, the alternative desalination plant sites are located in TA 1B, the deep-well injection sites in TA 2B, and the evaporation pond alternative in TA 1A.

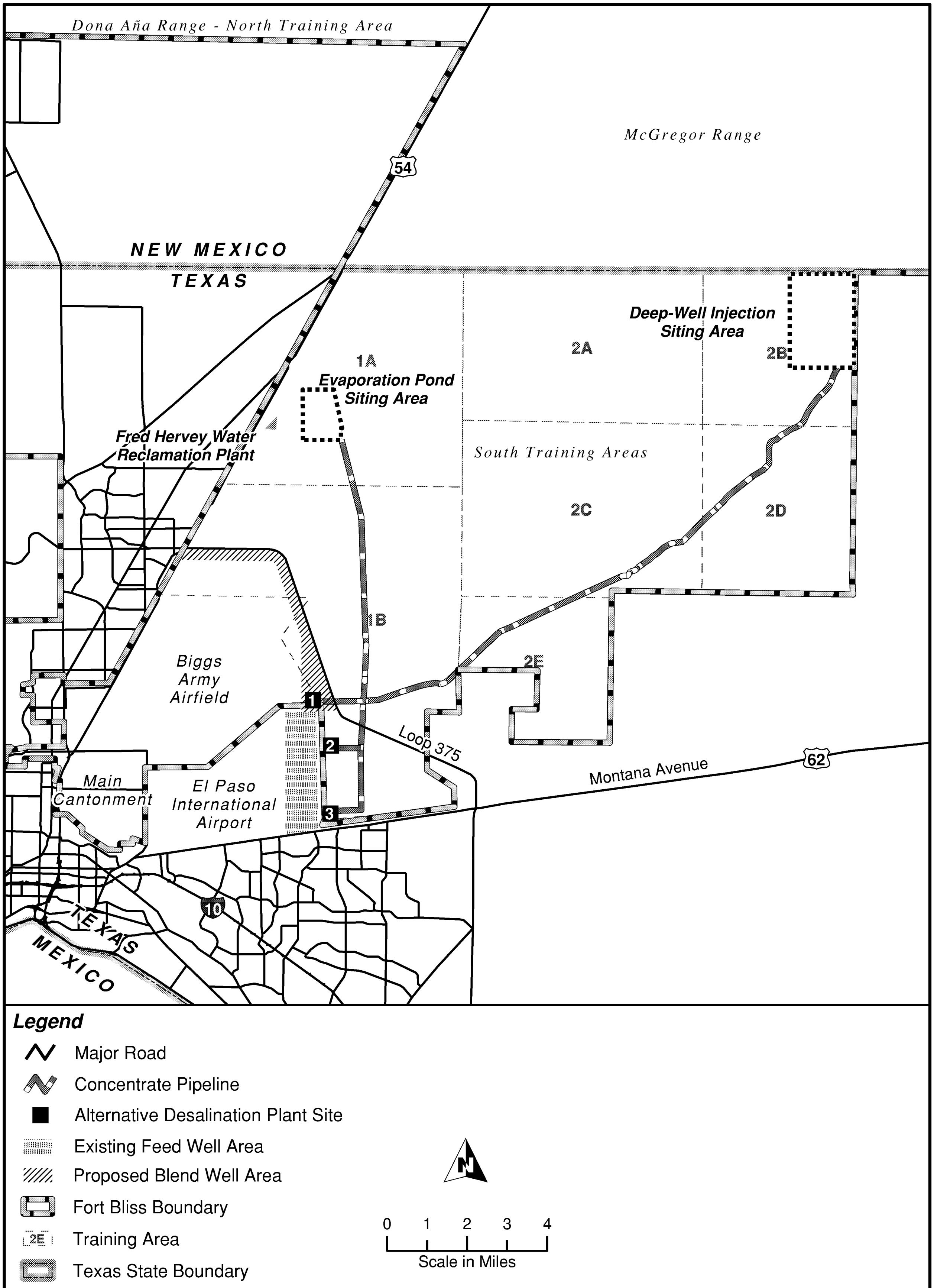


Figure 2-6. Alternative Locations for the Proposed Desalination Plant and Disposal Sites

2.2.1.1 Alternative Locations for the Desalination Plant

The area of study for the desalination plant was limited to the southwest corner of the Fort Bliss reservation bounded by Purple Heart Memorial Highway (Loop 375) to the north and east, EPIA to the west, and Montana Avenue (US 62/180) to the south. This area of Fort Bliss was selected based on the following criteria:

- Compatibility with current and future activities at Fort Bliss and EPIA;
- Avoidance of archaeological/cultural and natural resources;
- Proximity to the existing EPWU feed wells and transmission pipeline tie-in;
- Accessibility;
- Constructability; and
- Public acceptability.

Three locations for the desalination plant are analyzed. All three are in Training Area 1B. The analysis assumes that the design of the proposed desalination plant itself would be the same at all three locations. Construction requirements for the supporting infrastructure, consisting of a parking lot, paved road, utility lines, and pipelines, would vary slightly among the three locations to support the location and topography of the respective sites. The three candidate sites for the desalination plant are shown in **Figure 2-7**. All three sites are near to existing airport wells and the proposed blend wells, as well as the Montana Reservoir and Booster Station, and they are accessible from Loop 375 or Montana Avenue.

Site 1 is the candidate location closest to Loop 375 and the proposed blend wells adjacent to Loop 375. The site is undisturbed, and lies in an area that is free of known cultural resources. The soil in the area is sandy. Dunes covered with mesquite, creosotebush, and desert annuals such as spectacle pod and tansy mustard characterize the landscape. Among the three candidate locations, it is the site that is farthest from residential areas, and the least accessible for water and sewer connections.

Site 2 is located near the southern end of the proposed blend well field. It is also composed of undeveloped land in an area that contains no known cultural resources. Soils and landscape at Site 2 are similar to Site 1.

Site 3 lies in the extreme southwest corner of the South Training Areas, approximately 2,000 feet north of Montana Avenue. It is undisturbed and free of known cultural resources. Soils and landscape at Site 3 are similar to Sites 1 and 2. Among the three candidate locations, it is the site that is closest to residential areas and the most accessible for water and sewer connections.

All three sites would be accessed from Montana Avenue by a new two-lane paved road. Fencing would be placed around the facility and along access roads so plant employees and visitors would be able to visit the plant without passing through Fort Bliss security. Pipelines and utility connections would be placed underground for security and to avoid interference with military activities conducted in the South Training Areas.

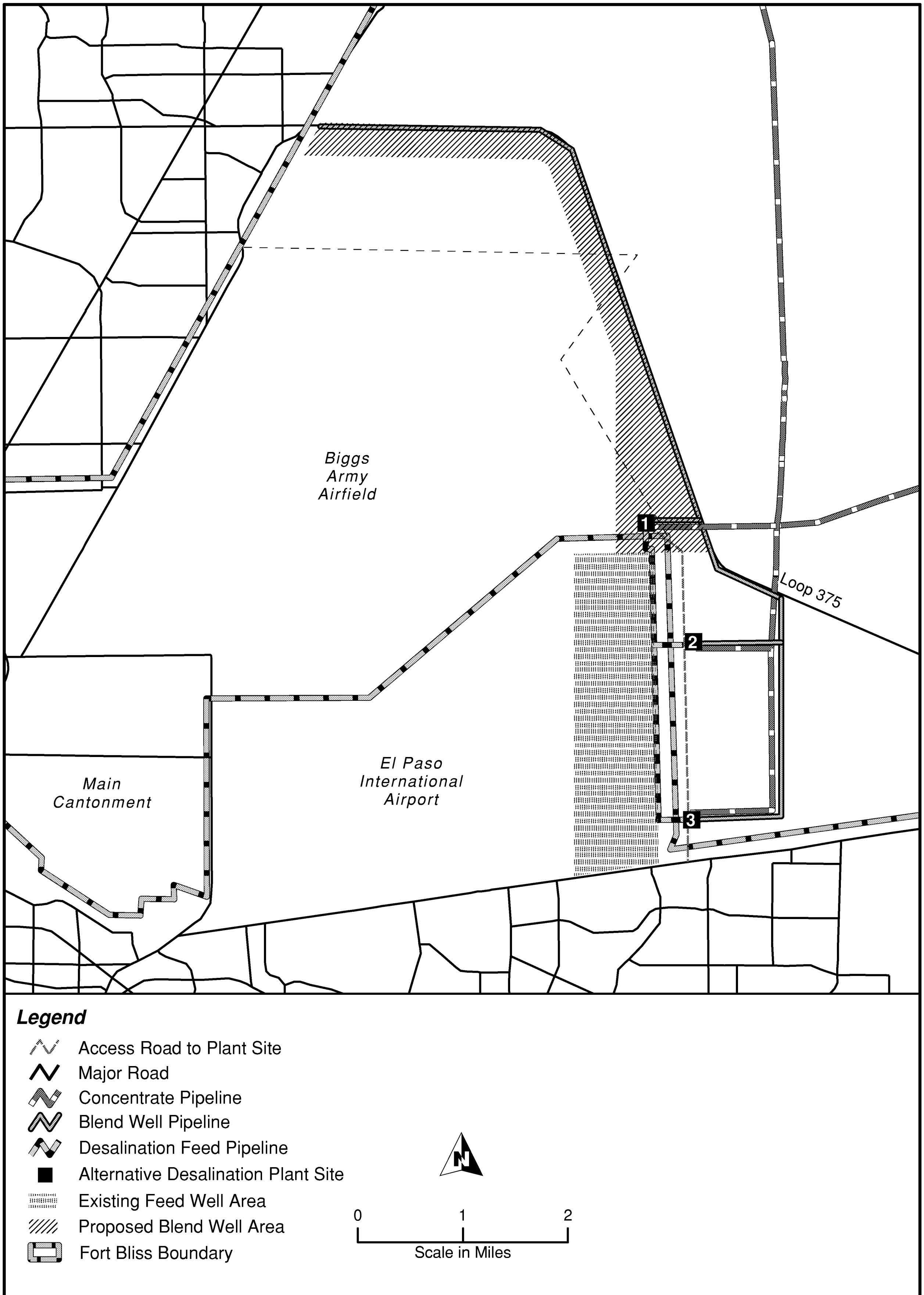


Figure 2-7. Alternative Desalination Plant Sites, Well Locations, and Connecting Pipelines

2.2.1.2 Location of Feed Wells, Blend Wells, and Associated Pipelines

The proposed desalination plant would treat feed water drawn from 15 existing EPWU wells located on the east side of EPIA. These wells are currently estimated to produce 18.5 MGD of feed water. The feed water would be conveyed through underground HDPE and/or PVC pipes to the desalination plant (see Figure 2-7). Blend water to be mixed with the permeate would be drawn from 16 new wells located along Loop 375 (see Figure 2-7) in Training Area 1B and also conveyed to the desalination plant through underground HDPE and/or PVC pipes. It is estimated that the blend wells would produce 12 MGD of water.

2.2.1.3 Alternative Locations for Disposal of the Concentrate

Deep-Well Injection Site

The primary criteria used to select potential injection well sites were geologic and hydrogeologic feasibility. To meet UIC permitting standards, suitable sites for underground injection of wastewater must have the following characteristics:

- Thick sedimentary layers including porous and permeable rocks for the injection zone and relatively impermeable rocks for the surrounding structure that confines the injection zone;
- A relatively simple geologic structure (free of complex faulting and folding);
- A low risk of induced seismicity (earthquake activity) by injection; and
- No mineral resources in the injection zone, and water quality similar to that of the material to be injected.

The Basis of Design Document: *Brine Disposal – Fort Bliss/EPWU Joint Desalination Facility,* July 26, 2002 (MC*i*/CDM 2002) explains the details of the process used to select and evaluate potential injection sites against the UIC standards. The evaluation includes:

- Spatial data analysis using regional surface geology and El Paso water well yield and quality.
- Evaluation of geophysical logs, formation descriptions, and water analyses of the Hueco Bolson.
- Water quality at various depths, taken from existing reports.
- Four aquifer characteristics (transmissivity, pressure buildup, wastewater travel distance, water chemistry).

The detailed analysis revealed three potential locations for wastewater deep-well injection:

- The San Elizario area in the El Paso Valley, south of El Paso, close to the United States-Mexico border.
- Northeast Geothermal Area on Fort Bliss, in Texas, near the New Mexico state border.
- Nations Wells Area north of US Highways 62 and 180.

Because of the high cost of acquiring more specific geologic information, EPWU selected one location for more detailed analysis. Based on the evaluation of existing data, including extensive studies of the geothermal fields in southern McGregor Range (USACE 1999), the Northeast Geothermal Area was determined to be the best option. As a preliminary step in the permitting process, existing information and a field evaluation of surface features relevant to this location were examined (MC*i*/LBG-Guyton Associates 2003). The objectives of this study were to refine the location of the injection site, provide information required by the TCEQ, provide information needed for design of the injection facility, and provide information for further site evaluations. Information and surveys included in the study concentrated on the area within a distance of five miles of a preliminary site near the Texas-New Mexico Border. The study included data compilation, field-data surveys, and a gravity survey. As a result of the study, locations of test holes for further study were identified on the basis of subsurface data needs, ease of access, and avoidance of restricted areas. Studies of those test holes (TetraTech/NUS 2003) characterized the injection zone and assessed its ability to contain concentrate from the proposed desalination plant.

Figure 2-6 shows the area in which the test holes have been drilled and where the final injection sites are expected to be located. Three to five injection sites are anticipated to be constructed to provide flexibility and back-up capability.

At this stage, four test injection holes have been drilled, and preliminary slug tests have been conducted on three of the wells. Modeling studies of the tests indicate that injection is technically feasible, and that injected concentrate would remain confined to the stratum into which it is injected (Hutchison and Granillo 2004a). Additional injection tests are required prior to issuance of a UIC permit to refine estimates of the conductivity and storage capacity of the injection zone and to demonstrate that the concentrate will be contained.

During further testing to be conducted after the EIS process is completed, final decisions would be made on the number of injection wells that would be used (anticipated to be between three and five) and the exact location of the wells. However, the wells would be located in the general area outlined in Figure 2-6, and the new injection wells may be located near the existing test wells. Each injection well site would occupy an area of approximately 0.7 acre. The injection wells would be supplied by underground piping that would allow injection at different wells depending on the rate at which the injected concentrate is being accepted by the target zone at each well.

The length of the pipeline for conveying the concentrate from the desalination plant to the injection sites would vary from 16.8 to 19.1 miles, depending on plant site.

Evaporation Ponds

The site selection study area for the evaporation ponds was bounded by the Texas-New Mexico state boundary to the north, the Hueco Mountains to the east, Horizon Boulevard to the south, and Loop 375 to the west. Detailed information on site selection is provided in the July 26, 2002 Basis of Design Document (MC*i*/CDM 2002). This document outlines a three-level screening process using the following eleven criteria:

- Current land use;
- Future land use;
- Ownership and availability;
- Proximity to developed areas;
- Acreage available;
- Distance to proposed desalination plant;
- Ability to obtain pipeline easement to site;
- Proximity to utilities;
- Soil type;
- Constructability; and
- Public acceptance.

The initial screening evaluated 32 preliminary potential sites in the study area and retained 13 potential sites. For the second level of screening, five of the screening criteria were modified – current land use, ownership, proximity to developed areas, acreage available, and constructability – and a twelfth criterion, environmental sensitivity, was added. The third level of screening, which included a detailed feasibility and cost analysis, evaluated the top five sites. The site adjacent to the existing FHWRP (**Figure 2-8**) in Training Area 1A was found to be the most preferable. It performed the best in all three analyses. This site includes a combination of existing EPWU land and adjacent Army land on Fort Bliss.

The evaporation ponds would be fed by a new pipeline from the desalination plant. The length of the pipeline would vary from approximately 11.5 to 13.8 miles, depending on the alternative plant site.

2.2.1.4 Project Implementation

This section describes the real estate action that would be undertaken by the Army to provide use of Fort Bliss land for the proposed desalination project, the construction activities, and operation of the desalination plant and other facilities after construction under all of the action alternatives.

Real Estate Action

The total amount of Fort Bliss land needed by EPWU depends on the concentrate disposal method selected and the final locations of the pipelines. **Table 2-3** provides the approximate acreage required for each project component.

Table 2-3. Approximate Acres of Army Land Required for the Proposed Project Components

Project Component/Site	Approximate Acreage
Desalination Plant Site and Pipelines from Feed Wells	36.5
Blend Well Sites (16)	3.7
Pipelines from Blend Wells to Plant	35.8
Concentrate Pipeline to Deep-Well Injection Site (from Loop 375)	57.4
Deep-Well Injection Sites (3-5)	0.7-1.1
Concentrate Pipeline to Evaporation Ponds	25.8
Evaporation Ponds (Fort Bliss land only)	394.0

Source: Klaes 2004b

The land agreement process includes the following three phases:

- Right-of-entry for construction;
- Construction and survey; and
- Easement.

Figure 2-8. Evaporation Pond Site Layout

Prior to any construction, EPWU must have the legal right to disturb the federally controlled land. The right-of-entry would be requested through the Commander of the U.S. Army Air Defense Center, Fort Bliss to the U.S. Army Corps of Engineers District Engineer in Fort Worth, Texas. A granted right-of-entry would establish the conditions for the subsequent construction. It would address the EPWU responsibilities for communicating with Fort Bliss staff on construction schedules and deconflicting any potential impacts on Fort Bliss military missions. It would also establish EPWU responsibilities to meet environmental protection and resource conservation regulations.

Upon completion of construction, surveys of the actual facility boundaries and pipeline routes would provide the property descriptions for the final easements. The easement could be established in perpetuity or for a defined period. It would be the contract between the federal government and EPWU.

Construction

For the purpose of analysis, it is assumed that under any of the action alternatives, construction of the proposed desalination plant and supporting infrastructure would take approximately 18 months, starting near the end of calendar year 2004, and plant startup would occur in early 2006. Projected start and completion dates for construction of the proposed desalination plant and its infrastructure are assumed to have little variation among the action alternatives.

Table 2-4 summarizes the construction characteristics of the pipelines associated with different components of the desalination process. The pipelines leading from the feed wells and blend wells to the desalination plant, as well as the pipeline connection from the plant to the EPWU distribution system, will be constructed in concert with well and plant construction. Construction of the concentrate disposal pipeline could take up to 235 days, depending on the disposal alternative selected (the longest would be for deep-well injection). About 500-800 feet per day of pipeline would be constructed on average. Standard construction specifications prohibit construction contractors from leaving open trenches unattended, so all trenches would be backfilled and closed at the end of each day.

Table 2-4. Pipeline Characteristics

Pipeline	Composition	Diameter	Estimated Length (in miles)		
			Site 1	Site 2	Site3
Feed Water Collector Lines	HDPE and/or PVC	36 inches	4.5*		
Blend Well Collector Lines	HDPE and/or PVC	Various up to 42 inches	5.9	7.5	9.2
Finished Water Distribution Line	HDPE and/or PVC	36 inches	0.5	0.9	2.6
Concentrate Line to Injection Site	HDPE and/or PVC	18 inches	17.3	19.8	21.5
Concentrate Line to Evaporation Ponds	HDPE and/or PVC	18 inches	12.0	12.9	14.6

Source: Klaes 2004b, SAIC

* Includes 800 feet on Fort Bliss and 22,700 feet on EPIA land.

Construction of the proposed desalination facility and associated pipelines and access roads is estimated to disturb between 218 and 228 acres of land (deep-well injection alternatives) and between 936 and 946 acres of land (evaporation pond disposal alternatives). The major difference in acreage between the two concentrate disposal alternatives is due to the land disturbance associated with construction of the evaporation ponds.

Construction may reveal previously unidentified archaeological or natural resources. Archeologists will monitor all ground-disturbing activities. Construction plans will include an active monitoring of sites for cultural and natural resources. If any are identified, either construction would be moved to avoid impacts, or impacts would be mitigated in compliance with Section 106 of the National Historic Preservation Act. This potential exists particularly for pipelines. If any human remains or other Native American funerary or sacred objects are discovered during construction, the provisions of the Native American Graves Protection and Repatriation Act will be adhered to (see Section 4.9).

The cost of project construction would be between $72 million and $91 million, depending on the plant site and disposal alternative selected. The major factor affecting the difference is the cost of the deep-well injection and associated pipelines ($13.5 million) compared to the evaporation ponds and associated pipelines ($32.5 million). The desalination facility itself would cost $26.5 million, and the new blend wells and associated pipelines would make up the remainder.

During construction, approximately 25 full-time equivalent workers would be employed to build the plant and deep-well injection facilities. Construction of the evaporation pond alternatives would employ a total of about 30 equivalent full-time workers. Between 10 and 20 workers would be employed during installation of the liners.

Construction specifications for the project would include sustainability principles to reduce pollution, waste generation, and energy consumption. These would include measures such as reducing site disturbance, erosion control, stormwater management, reuse of on-site materials, use of local/regional materials, and minimal use of wood products (Trzcinski 2004b).

Operations

A full-time staff of 16 persons is anticipated to be employed to operate and maintain the desalination plant. There would be no full-time employees at the injection site. The evaporation pond alternatives would employ one or two additional employees at the evaporation pond disposal site.

Pipeline maintenance requirements are expected to be minimal. The HDPE material expected to be used for the pipelines has an estimated useful life of 50 years or more, therefore it is not expected to be replaced during the life of the project unless there is a break in the line. If a line breaks, the affected section would be replaced. Salt and minerals are not expected to accumulate on pipe walls, so no significant cleaning would be required. Minor cleaning may be performed periodically as required.

Small quantities of materials and fuels would be consumed in the course of day-to-day operations. The quantity of hazardous waste that would be generated at the facilities is expected to be small enough that no special storage or disposal facilities or permits would be required.

Peak electrical demand at the desalination plant, which would also include the water wells and pipeline pumps, is estimated to be 4.5 megavolt-amperes (MVA). Electrical supply to the plant site, feed and blend wells, and evaporation ponds would be provided by El Paso Electric Company through two existing feeders (for redundancy). If deep-well injection is selected as the concentrate disposal alternative, power to the injection well sites would need to be provided, either by tying into an existing power source or through a combination of solar panels and gas or diesel-powered generators. The route of any new utility lines across Fort Bliss land would be surveyed for cultural resources prior to any ground disturbance.

TCEQ requirements for delivery assurance require a water treatment and delivery facility to have an alternative means of providing water in the event of a power outage or natural disaster. An integrated operating system incorporating the existing Montana ground storage tank and booster pumps would be used to meet this requirement. A dedicated gravity transfer line from the proposed desalination facility clear well would be used to supply the Montana storage tank. This gravity flow would maintain the Montana storage at a near full level at all times. A high-lift pump at the Montana station would provide circulation through the tank by pumping from the Montana tank to the distribution system.

The proposed desalination plant and its supplying well fields would be fed from a substation different from that feeding the Montana booster pump station. The Montana booster pumps would then be available to pump from the storage tank if the desalination facility experienced a power failure. There is an independent gas-driven pump located at the Montana station to be used in times of power outage at that facility. The Montana tank has sufficient capacity to provide 2.5 hours of service at the combined Montana booster pump capacity of 26 MGD. This would eliminate the need to install the electrical equipment to provide full emergency power to the proposed desalination plant and supply wells. It would keep water circulating through the Montana tank and exercise the Montana booster pumps. The gas-driven pump is available to maintain service to distribution in the unlikely event of power loss to both the proposed desalination facility and the Montana pump station.

2.2.2 No Action Alternative

Under the No Action Alternative, the Army would not provide land on Fort Bliss for construction and operation of the proposed desalination plant. None of the proposed facilities would be constructed on Army land at Fort Bliss. This alternative could, however, include one of the following actions without Army action or participation:

- Construction and operation of a desalination plant on non-Army land (e.g., Dell City);
- Increase in water conservation measures;
- Development of other water sources in the El Paso region;
- Importation of water from areas outside El Paso.

Without the proposed desalination project, both Fort Bliss and EPWU would continue pump from the freshwater layer of the Hueco Bolson until it no longer met drinking water standards. The quantity of withdrawals would depend on demand, the effectiveness of water conservation measures, and the availability of other water sources, and is expected to be approximately the same whether or not the proposed desalination plant is built. While the quantity would be approximately the same, under the No Action Alternative, the withdrawals would occur from the freshwater layer of the bolson instead of from the brackish layer.

2.2.3 Preferred Alternative

CEQ regulations (40 CFR 1502.14[e]) and Army Regulation 200-2 require the Draft EIS to identify a preferred alternative, if one has been selected. A preferred alternative must be identified in the Final EIS unless precluded by law. The Army has not yet selected a preferred alternative among the alternatives analyzed in detail in this Draft EIS. The preferred alternative will be identified in the Final EIS.

2.3 COMPATIBILITY OF THE PROPOSED ACTION AND ALTERNATIVES WITH THE FORT BLISS MISSION

The South Training Areas where the proposed project facilities would be constructed are designated for training in off-road vehicle maneuvers, on-road vehicle maneuvers, and dismounted training. There are several environmental restrictions dispersed throughout the South Training Areas, which are also available for public access within Fort Bliss guidelines (USAADAC&FB 1998).

The proposed desalination plant and supporting facilities are expected to be compatible with the current and potential future military missions of Fort Bliss. Training and other activities may be temporarily affected during construction, but no long-term limitations are anticipated. The following sections address the compatibility of each project component with military activities conducted in the South Training Areas.

Alternative Desalination Plant Sites

The area where the three potential desalination plant sites are located, Training Area 1B, is used for limited close-in training, primarily "dismounted" training by personnel on foot. It is bounded by residential land use to the south, airports to the east, and major highways to the north and east. The location of the alternative plant sites on the southwestern edge of the training area, close to Biggs AAF and EPIA, minimizes any adverse impacts to military training use of the area. To ensure compliance with federal regulation, sites were identified to avoid known archaeological resources. The desalination plant site itself would be fenced to limit public access, removing a small portion of the South Training Areas from public access. Given the amount of land available for public access, the impact would be negligible.

Blend Wells

The proposed blend wells would be located along Loop 375 in training Area 1B. Construction and operation of the blend wells is not anticipated to affect training or other Fort Bliss mission activities.

Concentrate Disposal Site – Deep-Well Injection

The proposed deep-well injection site is located in Training Area 2B in the northeast corner of the South Training Areas. Training Area 2B is used for off-road vehicle and dismounted training. The compatibility of the proposed action with Army training would depend on the final size, number, and location of the wells. Locations closest to the edge of the installation boundary would be more compatible with training activities. Fort Bliss will approve the final locations and design of the wells, including fencing, marking, and lighting, to ensure that training value is not degraded. In general, it is expected that the sites would be small (about a quarter acre each) and areas between the wells would still be usable for military training, thereby minimizing any adverse mission impacts. EPWU or other personnel accessing the injection well sites would be required to sign on and off the Training Area to ensure safety. Under these conditions, the proposed use is considered compatible with military training in this area.

Concentrate Disposal Site – Evaporation Ponds

The site under consideration for the evaporation ponds is located on and adjacent to the existing FHWRP in Training Area 1A. This training area receives a relatively low level of military use (USAADAC&FB 1998). The additional land that would be used for the evaporation ponds is bounded by utility easements to the south and east. In general, construction and operation of evaporation ponds in this area is not expected to appreciably affect current or future military training and is considered compatible with the

Fort Bliss mission. However, with this alternative disposal method, less land would be available for future military training use. To limit access from wildlife and from the public, the entire evaporation pond site would be fenced with 6- to 8-foot chain link fence topped with either barbed or concertina wire, and with appropriate reflective warning signs.

Pipelines

The pipelines from the feed wells and blend wells to the desalination plant and from the plant to the water distribution system would be located along or near roadways or in parts of the South Training Areas not expected to be used for training using armored vehicles and heavy equipment. This portion of Training Area 1B is primarily limited to light off-road vehicle use and dismounted training. It is also accessible for public use by permit. During construction, use of the area for training may be temporarily affected, but, outside of the fenced area around the desalination plant site, no long-term curtailment of training is anticipated after construction. Similarly, public access may be limited during construction, but no long-term impact is expected outside the fenced plant site. The pipelines would be routed to avoid known archaeological sites.

The pipeline for the concentrate would traverse Training Areas 1B and 2B, C, D and E if deep-well injection is selected, and Training Areas 1 A and B if evaporation ponds are selected as the disposal method. These areas support on- and off-road tracked and other heavy vehicle maneuvers and dismounted training, as well as public access, and are an important current and future training resource for the Army. The South Training Areas are a major part of Fort Bliss that can support off-road maneuvers with heavy equipment (e.g., tanks).

The concentrate pipeline is planned to follow existing utility corridors and run parallel to existing range roads and trails to the extent possible. The design specifications require that the entire pipeline be buried with sufficient cover to withstand the weight of an M-1 tank on a carrier, the heaviest load anticipated to use the South Training Areas. To define the design requirements, EPWU used locomotive loads to develop preliminary calculations for pipe wall thickness and cover and added a margin of safety (Klaes 2004a). The pipeline would have cut-off valves located at various intervals to allow segments to be isolated for repairs in the event of damage. The valves would be buried and hardened to also withstand the M-1 tank and carrier load. With these design standards, the pipeline is not expected to cause any long-term limitation on current or future Army training in the South Training Areas.

Training could be temporarily curtailed during construction of the concentrate pipeline. If deep-well injection is selected as the disposal alternative, construction could take as long as 235 days. However, only a portion of the pipeline would be constructed at any one time, so the entire length of the pipeline would not be affected for the entire construction period. The pipeline routes have been selected to avoid known archaeological resources. Public access to the affected areas could be limited during construction. After construction is complete, the pipeline is not expected to affect public access to the South Training Areas.

2.4 COMPARISON OF ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

Table 2-5 provides estimates of the ground disturbance that would occur during construction at each project component under each action alternative. **Table 2-6** compares the environmental impacts the action alternative. Impacts are discussed for each alternative site for the desalination plant and each disposal method. The alternatives under consideration by the Army are combinations of desalination plant locations and concentrate disposal methods. A brief summary of each alternative is provided below.

Table 2-5. Estimated Ground Disturbance by Action Alternative

Project Component	Acres Disturbed During Construction					
	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Desalination Plant Site	31.0	31.0	31.0	31.0	31.0	31.0
Access Road to Plant	41.7	27.8	6.9	41.7	27.8	6.9
Pipelines from Feed Wells to Plant	24.3	24.3	24.3	24.3	24.3	24.3
Pipeline Corridor between Plant and Loop 375*	3.9	6.8	20.2	3.9	6.8	20.2
Blend Wells and Pipelines along Loop 375	33.2	40.1	40.1	33.2	40.1	40.1
Deep-Well Injection Wells**	1.1	1.1	1.1			
Pipeline from Loop 375 to Injection Site	91.6	103.3	103.3			
Evaporation Ponds				748.6	748.6	748.6
Pipeline from Loop 370 to Evaporation Ponds				62.7	65.5	65.5
Total	227	234	227	945	944	937

* Single corridor containing blend well pipeline, finished water pipeline, and concentrate pipeline.
** Based on five wells.
Source: Adapted from Klaes 2004b

Alternative 1

Under this alternative, construction of the desalination plant site and access road would disturb approximately 72-73 acres, increasing the risk of erosion and increasing short-term air pollutant emissions. During operation of the plant, there would be an increase in power consumption. Hazardous materials would be stored and used at the plant site, and there would be a slightly increased risk of an accidental spill of hazardous materials or waste at the site or during transportation of chemicals to or from the site. The development of Site 1 could conflict with the alignment of a planned connection from Loop 375 to EPIA and would require redesign of the access around the site. EPIA is in the process of revising its Master Plan.

Traffic would increase slightly along Montana Avenue and Loop 375. Access to Site 1 would be along a new roadway from Montana Avenue, which could have a minor adverse impact on traffic flow along this already congested route. Montana Avenue provides access to residential areas to the south and east, including areas that have higher than average minority and low-income populations.

Construction of the blend wells and the pipelines from the feed wells and blend wells to the plant site would disturb about 61-62 acres. Pumping from the existing feed wells would increase drawdown (lowering of the water table) of the groundwater level in the immediate vicinity of the wells by up to 90 feet, which would be up to 60 feet more than the drawdown projected without the desalination project. This could increase subsidence in the area around the desalination plant to a minor extent. The magnitude of the drawdown would diminish with distance out to about 5-10 miles around the plant site. A similar although less pronounced drawdown would occur around the new blend wells. In order to pump the same total quantity of water from the aquifer as would be pumped without the desalination project, EPWU's plan is to reduce pumping from its other wells northwest of the project area. The reduced pumping would have the beneficial effect of impeding intrusion of higher salinity water into the area of the blend wells and existing water wells on Fort Bliss.

Construction of deep-well injection wells would disturb less than a quarter of an acre of land and vegetation at the each of three to five injection sites and about 91-92 acres for installation of the concentrate pipeline from Loop 375 to the injection site. There would be a small risk of contamination of soil and the surficial aquifer with salts from the concentrate if there were a break or leak in the pipeline. Injection of concentrate at the wells could slightly increase the risk of localized low-intensity earthquakes by changing internal pressures within geologic formations. The injection site is located near a geothermal resource, and there is a small risk that deep-well injection of cooler water could interfere with future exploitation of this resource. However, available evidence indicates that concentrate injection would not affect geothermal resources. All other impacts would be negligible.

Alternative 2

The impacts from development of Alternative 2 would be essentially the same as Alternative 1. Total area disturbed during construction would be about 7 acres more than under Alternative 1. The desalination plant in this alternative would be exposed to a slightly higher level of noise from aircraft operations at EPIA and Biggs Army Airfield (AAF) than under Alternative 1. However, the noise level would not be incompatible with the industrial activities at the plant.

Alternative 3

The impacts from development of Alternative 3 would be similar to Alternatives 1 and 2. Ground disturbance during construction would be about the same as Alternative 1. Although the distances between Plant Site 3 and the blend wells and the injection site would be longer, the access road would be shorter. Plant Site 3 is located in an area identified by EPIA for possible future industrial development, although EPIA is in the process of updating its Master Plan. If this site is selected for a desalination plant, other development would have to be located around the plant. This is not expected to adversely affect EPIA plans. The plant would be compatible with the type of industrial development anticipated by EPIA.

Alternative 4

Alternative 4 would have the same impacts from construction and operation of the desalination plant, blend wells, and feed and blend well pipelines as Alternative 1. It would differ in the impacts associated with disposal of the concentrate. The impacts from deep-well injection described for Alternative 1 would not occur under Alternative 4.

The construction of evaporation ponds would disturb as much as 748-749 acres of soil and vegetation with associated increases in soil erosion and dust emissions. After construction, about 680 acres would be converted into evaporation ponds. The increased ground disturbance for the ponds would be offset somewhat by the shorter length of the concentrate pipeline, which would disturb about 62-63 acres compared to the 91-92 acres disturbed under Alternative 1. The net difference would be about 703-718 more acres disturbed for the evaporation pond alternatives than the deep-well injection alternatives.

The ponds would be large and very visible, especially from elevated locations, although the existing landscape in this area is relatively featureless and undistinguished. During operation, there would be a minor risk of contamination of soil and the surficial aquifer by concentrate due to leaks or breaks in the pond liner or the pipeline leading from the desalination plant to the ponds. During certain weather conditions, there is a possibility that odors from the ponds would be noticeable from nearby residential areas, although they are not expected to be stronger than odors currently experienced from the existing oxidation ponds at the Fred Hervey Wastewater Reclamation Plant and a neighboring food processing plant.

The evaporating concentrate would have the potential to cause salt toxicosis and other toxicity in birds attracted to the ponds. If a large number of birds were attracted to the area, there would be a small risk of an outbreak of avian botulism. However, this site is not known to be used by large numbers of birds.

The evaporation ponds would produce approximately 100 tons per day of solids (primarily salt) requiring disposal in an appropriate landfill. This could exacerbate landfill capacity issues in El Paso.

Alternative 5

The impacts of this alternative would be essentially the same as Alternative 4. Ground disturbance during construction would be about the same. Desalination plant Site 2 would be exposed to slightly higher aircraft noise levels than Site 1.

Alternative 6

This alternative would be similar to Alternatives 4 and 5, with about 8 acres less of ground disturbance than Alternative 4. Land use impacts associated with desalination plant site would be slightly higher, as described for Alternative 3.

No Action Alternative

If this alternative were selected, none of the impacts described above and in Table 2-6 would occur on Fort Bliss land. Similar impacts could occur if a desalination project were developed on land outside Fort Bliss. If no desalination plant is built, freshwater supplies in the Hueco Bolson will continue to be depleted at a faster rate than with the proposed project. The length of time that freshwater resources would continue to be usable is not known and depends on other factors such as the amount of pumping, the effectiveness of conservation measures, drought conditions, and availability of other water sources. With continued pumping from existing EPWU freshwater wells, the intrusion of saline waters toward Fort Bliss wells would continue.

Table 2-6. Comparison of Action Alternatives

Resource	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Geology and Soils	Soil disturbance during construction. Increased risk of wind erosion on disturbed soils. Potential for subsidence around feed and blend wells due to groundwater drawdown (less than a foot over 50 years). Small risk of soil contamination if concentrate pipeline breaks or leaks. Slightly increased risk of localized low-intensity earthquake at deep-well injection site. Possible interference with future development of geothermal resources.	Same as Alternative 1, with slightly more soil disturbance and erosion potential.	Same as Alternative 1.	Soil disturbance during construction. Disturbance of up to 749 acres of soil at evaporation pond site during construction and conversion of about 680 acres for pond use. Increased risk of wind erosion on disturbed soils. Potential for subsidence same as Alternative 1. Small risk of soil contamination if evaporation pond liner or concentrate pipeline breaks or leaks.	Same as Alternative 4.	Same as Alternative 4, with slight less soil disturbance and erosion potential.
Water Resources	Changed pattern of aquifer drawdown with use of feed wells and new blend wells. Ability of injection zone to contain concentrate under pressure not fully determined. Small risk of contaminating surficial aquifer if there is a break/leak in concentrate pipeline. Slight risk of contaminating underground sources of drinking water.	Same as Alternative 1.	Same as Alternative 1.	Impact on aquifer drawdown same as Alternative 1. Small risk of contaminating surficial aquifer if there is a leak or failure of evaporation pond liners or concentrate pipeline.	Same as Alternative 4.	Same as Alternative 4.

Table 2-6. Comparison of Action Alternatives

Resource	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Utilities and Services	Slight increase in power consumption within El Paso Electric Company's service area.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1. Increase in solid waste generation of approximately 100 tons per day. Disposal location for residual solids from evaporated concentrate not determined.	Same as Alternative 1.	Same as Alternative 1.
Hazardous Materials, Hazardous Waste, and Safety	Small increased risk of release of hazardous materials during transportation and use. Slightly increased risk of release of hazardous waste at plant site. No ground or flight safety impacts.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Air Quality	Small increase in area-wide emissions during 18-month construction period. Negligible increase in area-wide emissions during operations.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1. Slightly higher increase in particulate matter emissions (dust) during construction of evaporation ponds.	Same as Alternative 4.	Same as Alternative 4.
Biological Resources	Disturbance of about 227 acres (less than 0.1 percent) of most common vegetation type on South Training Areas.	Similar to Alternative 1, with slightly more area disturbed.	Similar to Alternative 1.	Disturbance of approximately 945 acres (about 0.2 percent) of most common vegetation type on South Training Areas. Potential for salt toxicosis of birds attracted to the evaporation ponds; risk reduced by availability of large area of fresh and non-toxic water on site. Potential metal toxicity to	Similar to Alternative 4.	Similar to Alternative 4, with slightly less area disturbed.

Table 2-6. Comparison of Action Alternatives

Resource	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
				birds from new evaporation pond food chain. Small potential for outbreak of avian botulism should large number of birds be attracted to new ponds.		
Land Use and Aesthetics	Future connection from Loop 375 to EPIA would need to be located around plant site. Uniquely styled plant visible from Loop 375.	Same as Alternative 1. In addition, plant site in 65-75 decibel noise contour from EPIA and Biggs AAF operations, which is compatible with industrial facility.	Same as Alternative 1. In addition, future EPIA development currently planned for site would need to be located elsewhere.	Desalination plant impacts same as Alternative 1. Evaporation ponds highly visible from elevated areas west of site. Possible odors from evaporation ponds at nearby residential area.	Plant impacts same as Alternative 2. Evaporation ponds highly visible from elevated areas west of site.	Plant impacts same as Alternative 3. Evaporation ponds highly visible from elevated areas west of site.
Transportation	Slight adverse impact on traffic flow from access road off Montana Avenue to plant site.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Cultural Resources	No adverse impact anticipated with archaeologist on site during all ground disturbance.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Socioeconomics and Environmental Justice	Slight increase in employment and earnings. No disproportionately high and adverse impacts on minority or low-income populations.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 4.	Same as Alternative 4.

2.5 EASEMENT CONDITIONS AND MITIGATION MEASURES

If an easement is granted by the Army to EPWU for construction and operation of the proposed desalination project, it will include conditions to protect the military mission and avoid or mitigate adverse environmental impacts. In some cases, monitoring will be conducted to verify compliance with the conditions, assess the effectiveness of the mitigation measures, or provide data that might trigger additional mitigation. **Table 2-7** lists identified conditions and mitigation measures and indicates which would involve monitoring.

Table 2-7. Easement Conditions, Mitigation Measures, and Monitoring

Resource	Condition/Mitigation Measure	Monitoring	Alternative
Geology and Soils	Use dust suppression measures such as watering and application of soil stabilizers during ground disturbance (also Air Quality).		1–6
	Install pressure monitors in the concentrate pipelines to detect leaks and or catastrophic failure.	X	1–6
	Install a leak detection system under the evaporation ponds to allow early leak detection and corrective action.	X	4 – 6
Water Resources	Install pressure monitors in the concentrate pipelines to detect leaks and or catastrophic failure.	X	1 – 6
	Develop an emergency action plan to minimize the release of concentrate during an accident or equipment failure.		1–6
	Evaluate the presence or absence of a connection between the injection zone and other aquifers during deep-well injectivity tests.		1–3
	Install a leak detection system under the evaporation ponds to allow early detection and corrective action should leaks occur.	X	4–6
Air Quality	Water exposed soil frequently during construction to minimize fugitive dust.		1–6
Biological Resources	Avoid disturbing any arroyo vegetation that may be present.		1–3
	Maintain fresh water in the Fred Hervey oxidation ponds during bird migration to minimize potential salt toxicosis.		4–6
	Monitor bird deaths at the evaporation ponds for possible toxicosis and to determine whether further mitigation measures need to be implemented.	X	4–6
	Monitor chemical concentrations in evaporation ponds quarterly and conduct screening-level toxicological risk assessments every five years.	X	4–6
Transportation	EPWU coordinate access requirements with Fort Bliss to ensure maintenance of the deep-well injection facility and concentrate pipelines can be performed with minimal interference with the Fort Bliss mission.		1–3
	Design the entry and exit road from the desalination plant to Montana Avenue to minimize impact to traffic flow.		1–6

2.6 ALTERNATIVES ELIMINATED FROM DETAILED STUDY

2.6.1 Criteria for Identification of Reasonable Alternatives

Candidate alternatives were evaluated to determine whether they were technically and economically practical or feasible and met the overall purpose and need for the proposed action as described in Chapter 1. Because the purpose of the proposed action being evaluated by the Army is limited to the outgrant of land, alternatives not involving Army land or other Army action were considered outside the scope of this EIS. For the purposes of this analysis, other alternatives outside Fort Bliss are equivalent to the No Action Alternative.

In order to ensure consideration of the full range of alternatives, candidate alternatives within the scope of the EIS purpose were evaluated according to the following criteria:

- Technical and economic feasibility. The proposed action would be implemented by EPWU. Therefore, any alternative that was determined by EPWU to be infeasible or impractical was eliminated from detailed consideration.
- Differentiation of environmental consequences. Alternatives that were determined to be essentially indistinguishable from the proposed action in their environmental consequences were dropped from further consideration. This included alternative treatment methods that could be used in the desalination plant, which would involve essentially the same facilities, infrastructure, and energy requirements.
- Compatibility with the Army's mission at Fort Bliss. The South Training Areas of Fort Bliss are needed to support the current and future national defense and training missions of the Army. Alternatives with the potential for compromising or degrading that mission or that would not be compatible with training activities in the South Training Areas were eliminated from further consideration.

2.6.2 Alternative Sources of Water

It is anticipated that the proposed desalination project would be only one of multiple existing and future sources of potable water for the City of El Paso, as delineated in the RSWP EIS. Alternative sources not analyzed in the RSWP EIS could also be considered by EPWU as a substitute for or in conjunction with the desalination plant. For example, importing water from a desalination plant in Dell City as was suggested in a comment received during scoping for this EIS, although not a substitution for the proposed action, could be considered by EPWU as an additional source of potable water.

The Army's proposed action involves providing an easement for land on Fort Bliss, not developing water supplies. Therefore, analyzing the impacts of developing alternative water sources is outside the scope of this EIS. For the purposes of the Army's decision concerning the proposed action, alternative sources of water would be equivalent to the No Action Alternative.

2.6.3 Alternative Purification Technologies

In general, alternative treatment technologies were eliminated from detailed study because, as described above, their environmental impacts are expected to be essentially the same as those for the proposed action. A number of technologies have been used to produce fresh water from brackish water or seawater. Initially, most commercial desalination facilities were thermal-driven plants, analogous in scale and operation to chemical processing plants. Just as large-scale distillation towers are used to separate gasoline from heating oil and asphalt, distillation was used in most early commercial desalination plants to boil brackish water or seawater so that the resulting steam could be condensed as fresh water. (Only water or compounds that are as volatile or more volatile than water vaporize, leaving the salt behind.) However, boiling water is energy intensive and therefore expensive both in terms of environmental stress and monetary costs. With the improvement of desalination membranes, energy recovery, and operational experience, most new commercial desalination involves RO membranes, particularly for brackish water applications.

2.6.4 Alternative Uses for the Concentrate

The proposed desalination plant would be expected to produce approximately 3 MGD of concentrate. The concentrate is wastewater with high concentrations of dissolved minerals. In addition to subsurface deep-well injection or evaporation using surface ponds, options for disposition of highly concentrated brine water include:

- Enhanced evaporation using misting technology;
- Direct discharge to surface water;
- Recycling of brine (zero liquid discharge) using engineered solar gradient ponds;
- Development of recreational or ornamental lakes;
- Spray irrigation;
- Disposal as waste sludge;
- Secondary treatment and volume reduction (membrane concentrator); and
- Discharge to sewer, mixing and treatment with municipal effluent.

EPWU evaluated and eliminated these potential options for economic reasons, insufficient technology, or inappropriateness for the available locations or quantity of concentrate. The area's arid climate produces sufficient evaporation to not require cost-intensive misting. Desalination concentrate is not discharged to rivers and lakes because of adverse environmental impacts; however, it can be discharged to salt water seas. The closest saltwater body is 600 miles from the proposed site; therefore it is economically prohibitive to pump that great distance. Solar gradient ponds and volume-reduction technologies are effective in smaller capacity facilities, but economically preclusive for the quantity proposed. The development of recreational/ornamental lakes and the spray irrigation alternatives have potential adverse environmental impacts and depend on demand for those facilities. These alternatives may produce land uses not compatible with the Fort Bliss mission. Direct disposal as waste sludge has potential significant environmental impacts, and discharge to sewer is an economically inefficient method of treatment.

EPWU examined the possibility of applying the concentrate to beneficial use but did not identify any uses that were feasible and economical. Beneficial reuse will continue to be investigated if technically and economically feasible and practical.

2.6.5 Alternative Sites for Project Elements

2.6.5.1 Desalination Plant

Collocation With Concentrate Disposal Site

This alternative was not considered technically or economically feasible. Under full operation of the proposed desalination plant, water would be piped to and from the plant as follows:

- 18.5 million gallons per day through 36-inch pipes from the feed water wells to the plant;
- 12 million gallons per day through up to 42-inch pipes from the blend wells to the plant;

- 27.5 million gallons per day through 36-inch pipes from the plant to Loop 375 and the Montana Booster Station; and
- 3.0 million gallons per day through 18-inch pipes from the plant to the deep-well injection site or evaporation ponds.

In total, during daily operation of the proposed desalination plant, 61 million gallons of water would typically be conveyed through underground pipes to or from the plant. Under the action alternatives described under Alternatives Analyzed in Detail (Section 2.2), the proposed desalination plant would be located near the feed and blend wells and the Montana Booster Station. Approximately 58 million gallons per day of the water would be piped relatively short distances to and from the plant and the feed wells, blend wells, distribution lines, and Montana Booster Station. Only concentrate from the plant, 3 million gallons per day, would be piped over greater distances to the disposal location.

If the proposed desalination plant were collocated with the evaporation ponds or the deep-well injection site, it would be necessary to construct enough pipeline to pipe 58 million gallons of water per day over the larger distance and through relatively large pipes (36-42 inches compared to 18 inches for the concentrate). This would result in higher energy consumption, use of substantially more materials, and increased soil disturbance to install the required pipelines. Thus, collocation of the proposed desalination plant with either of the disposal sites would result in environmental disadvantages and higher costs.

Other Locations on Fort Bliss

Other locations on Fort Bliss include the Main Cantonment, Biggs Army Air Field, Doña Ana Range, and McGregor Range. All were eliminated from consideration because of incompatibility with the Army mission and, in the case of Doña Ana and McGregor Ranges, technical and economic impracticality. Due to the proximity of residential and commercial development, the sites in the South Training Areas under consideration are used for limited training. Doña Ana and McGregor Ranges are used for a variety of Army missions including live firing. Location of the proposed desalination plant or its supporting facilities would not be acceptable to the Army due to the potential interference with its missions. In addition, it would be impractical to transport the large quantities of water to and from the desalination plant over the extensive distances between EPWU distribution areas and the two ranges, which are located in New Mexico. Location on the Fort Bliss Main Cantonment and Biggs Army Air Field would also be unacceptable to the Army because of interference with Fort Bliss mission and security requirements.

2.6.5.2 Source Wells for Brackish Water

Selection of sites for the proposed desalination plant was influenced by the location of wells that could serve as sources of brackish water and proximity of a distribution point for finished water from the plant. Prior to selecting sites on Fort Bliss for the proposed desalination plant, the City of El Paso examined five locations that could serve as a source of brackish water for the proposed plant. The city's selection process was driven by consideration of the availability of brackish water and existing pumping capacity at each location (CH2M HILL 2001). Existing airport wells north of Montana Avenue and adjacent to the western boundary of Fort Bliss' South Training Areas were selected as the preferred source of brackish water based on selection criteria that included brackish water availability, existing infrastructure, proximity to the city's water distribution system, and access to areas for disposal of concentrate.

The city selected blend well locations in the area immediately south and west of Loop 375. Those locations were selected on the basis of calculations of the groundwater flow for the Hueco Bolson Aquifer (CDM 2002a; EPWU and USACE 2003). Flow patterns in the Hueco Bolson are complex due to ongoing pumping by the City of El Paso, Fort Bliss, and Ciudad Juárez, Mexico. The regional flow of groundwater in the Fort Bliss/El Paso area is characterized by the flow of fresh water from north to south and the encroachment of brackish water from the east to northeast directions. Hydrologic modeling was performed to evaluate the effects of pumping from the proposed blend wells on localized flow patterns in the bolson. The calculations show that the blend wells adjacent to Loop 375 would intercept the current flow of brackish water in the Hueco Bolson Aquifer, thereby forming a local barrier to the encroachment of brackish water into EPWU and Fort Bliss wells located west and south of the blend wells.

2.6.5.3 Concentrate Disposal Sites

Alternative Locations for Deep-Well Injection

Selection of the candidate location for deep-well injection was driven by technical requirements for capacity of the target zone and its isolation from fresh water supplies. Based on geological and hydrological data for the El Paso County area, the city considered three sites for deep-well injection of concentrate from the proposed desalination plant: one 16 miles south of El Paso near the Community of San Elizario and the Texas-Mexico border; another site approximately 18 miles northeast of El Paso in the Nations Wells Area; and a third site in the South Training Areas of Fort Bliss immediately south of the Texas-New Mexico border and approximately 15 miles northeast of candidate sites for the desalination plant (MC*i*/CDM 2002). The candidate injection site on Fort Bliss lies in a geothermal system that extends from New Mexico south into Texas, referred to as the Northeast Geothermal Area.

Simulations of injection-well conditions at the San Elizario site indicated that injected concentrate would not be isolated from fresh water, whereas concentrate injected in the Northeast Geothermal Area would have a minimal effect on water resources. Due to a lack of data for the Nations Wells Site, the city elected to explore the Northeast Geothermal Area on Fort Bliss as a preferred site for deep-well injection. Geological exploration of the Northeast Geothermal Area for a suitable injection site is now in progress. Data from initial findings (TetraTech/NUS 2003) have been incorporated in the evaluation of the environmental impacts of deep-well injection contained in this EIS.

The Northeast Geothermal Area was the only area on Fort Bliss that hydrogeological studies identified as suitable for deep-well injection. Among the three candidate areas for deep-well injection, the Northeast Geothermal area was found to offer the best isolation of concentrate from fresh water supplies.

Alternative Locations for Evaporation Ponds

The Fred Hervey Site was selected by the City of El Paso as the preferred site for evaporation ponds from among five candidate sites. It was preferred because of its closeness to the proposed desalination plant (approximately 10 miles from candidate sites for the proposed desalination plant), its current use as a site for oxidation ponds, and the existence of pipeline easements to the evaporation ponds. The adjacent Fort Bliss lands are the only areas of the South Training Areas where the operation of evaporation ponds would be compatible with current land use. Because the Fort Bliss land used for the evaporation ponds would be adjacent to an operational water reclamation plant, that location would offer minimal interference with Fort Bliss' missions. Since a portion of the evaporation ponds would be located on previously disturbed land on the Fred Hervey Plant grounds, use of the Fred Hervey site and adjacent Fort Bliss land would minimize land disturbance.

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3 AFFECTED ENVIRONMENT

Chapter 3 describes the existing environmental conditions in the region of influence (ROI) for ten resources: geology and soils; water resources; utilities and services; hazardous materials, hazardous waste, and safety; air quality; biological resources; land use and aesthetics; transportation; cultural resources; and socioeconomics and environmental justice. The ROI is defined for each resource and delineates the area where impacts from the proposed action and alternatives are expected to occur. This chapter provides a baseline for assessing the environmental consequences of the alternatives analyzed in detail as described in Section 2.2. The environmental consequences are discussed in Chapter 4.

3.1 GEOLOGY AND SOILS

This section addresses the overall physiography and stratigraphy of the project area and describes geologic structure, geologic hazards, mineral and geothermal resources, and soils.

The ROI for geology includes regional geology and site-related geological features of the Hueco Bolson Aquifer and the candidate site for deep-well injection. The ROI for soils includes sites for the proposed desalination plant, deep-well injection site, evaporation ponds, and pipeline routes connecting the proposed plant to wells and disposal sites.

3.1.1 Geologic Setting

3.1.1.1 Physiography

Fort Bliss lies within the Basin and Range physiographic province (**Figure 3-1**). During the past 30 million years, the earth's crust has extended throughout the province and produced characteristic short, linear mountain ranges separated by intervening valleys (Stewart 1978). The Rio Grande Rift Valley is a feature lying along the eastern side of the Basin and Range that extends from west Texas and northern Mexico northward through central New Mexico into the Southern Rocky Mountains. Near El Paso, Texas, the Rio Grande Rift Valley turns abruptly to the southeast.

The project area is located in the Tularosa-Hueco Basin, which is bordered on the west by the narrow north-south Franklin Mountains and on the east by the Hueco Mountains. The basin is over 200 miles long, extending north past the Texas-New Mexico boundary. It varies in width, averaging approximately 25 miles. The elevation of the greater part of the Hueco Bolson is approximately 4,000 feet. The mountains confining the Tularosa-Hueco Basin are 2,000 to 5,000 feet higher.

The Tularosa-Hueco Basin is separated into two distinct parts by a divide a few miles north of the Texas-New Mexico boundary. The northern part, known as the Tularosa Desert, trends north and south and is a closed basin with no drainage outlet. The southern part of the basin trends northwest and southeast, contains no salt or gypsum, and is crossed by the Rio Grande. The Rio Grande, which forms the western and southern boundary of El Paso County, flows through a narrows in northwest El Paso.

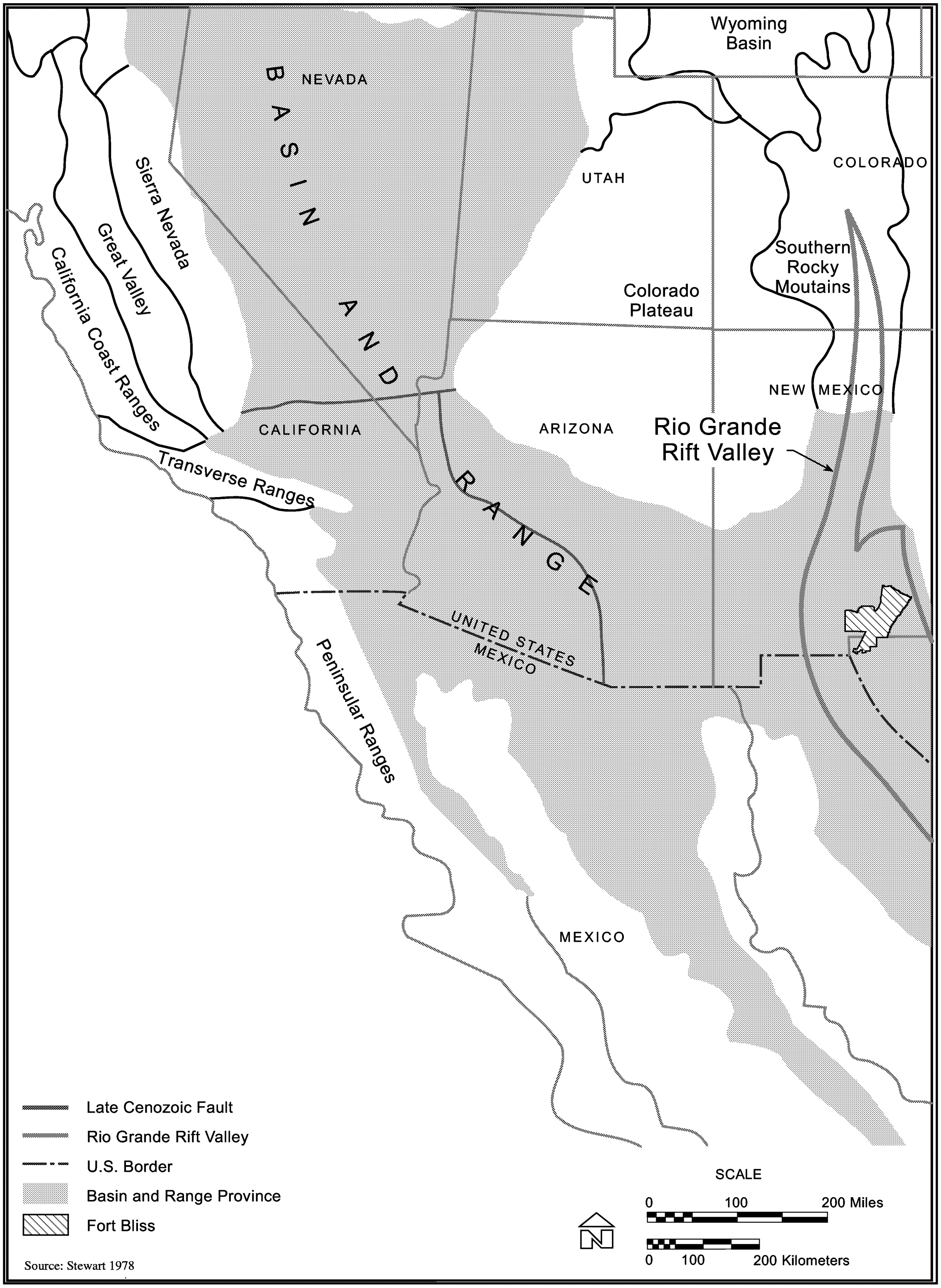


Figure 3-1. Physiographic Provinces and Late Cenozoic Faults in Western North America

3.1.1.2 Stratigraphy

The Tularosa-Hueco Bolson Basin contains thick deposits of eroded debris (Collins and Raney 1991). In the four slimholes drilled for geothermal exploration by Sandia National Laboratories (Finger and Jacobson 1997), depth to bedrock varies from 30 feet to 710 feet. Depth of bedrock can be up to 4,000 feet. Carbonate and felsite are the dominant rocks encountered under the basin-fill sediments (Witcher 1997).

The Fusselman Limestone under the basin-fill sediments is the target formation for injection of concentrate from the proposed desalination plant. Frequently, this formation shows high porosity and permeability (MC*i*/LBG-Guyton Associates 2003). The depth to the formation varies greatly because of faulting. UTEP (2004a) conducted a gravity anomaly study in the vicinity of the injection zones. Their analysis of faults, Digital Elevation Models, test holes, and gravity data led to the conclusion that the main structure in the area is a north-northwest-trending basin that is bounded by faults with significant offsets. This basin contains as much as 340 feet of low-density sediments and a thickened section of late Paleozoic strata. The location of one profile that goes through test holes 1, 3, and 4 (profile 2) is presented in **Figure 3-2**. **Figure 3-3** presents the interpreted structure along profile 2.

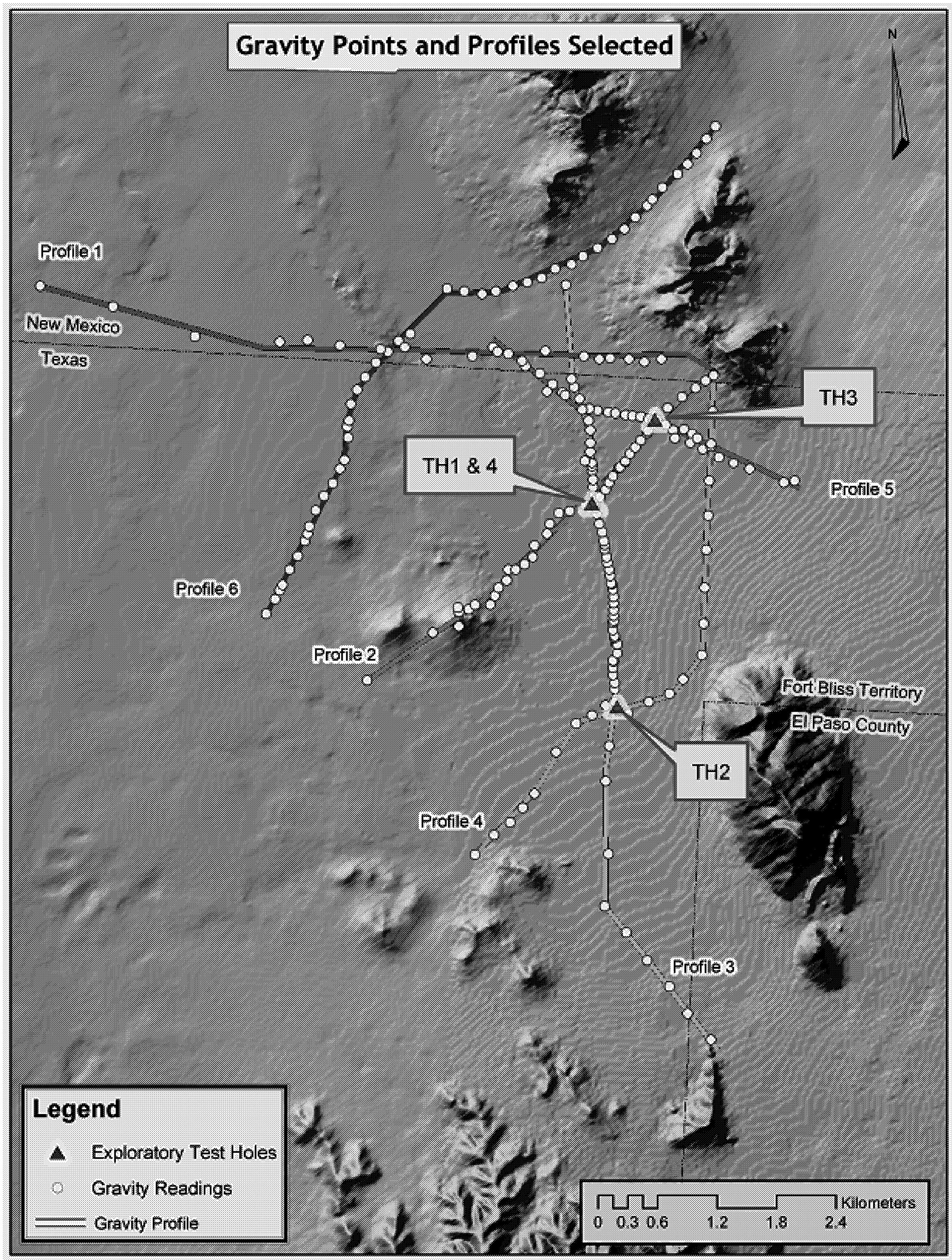
3.1.1.3 Structure

Beginning approximately 30 million years ago (Oligocene time), the crust in south-central New Mexico and west Texas was pulled apart as the Rio Grande Rift began to develop (Adams and Keller 1994). Rift basins produced 18-30 million years ago trend northeast and were accompanied by eruptions and intrusions of alkali igneous rocks. Rift basins formed between 10 million years ago and the present are oriented more northerly and were (and still are) accompanied by eruptions of basalt. The Tularosa Basin and the Hueco Bolson developed during this second period of rifting. The Tularosa-Hueco half graben (a basin bounded on one side by a fault) rotated downward to the west along an east-facing boundary fault — the East Franklin Mountain fault (Collins and Raney 1991; Seager 1980; Machette 1987). Seismic and gravity survey interpretations suggest that the thickness of basin-fill sediments is nearly 9,000 feet a few miles east of where the East Franklin Mountain fault reaches the surface (Witcher 1997).

Most faults in the vicinity of Fort Bliss are along the west sides of the Tularosa Basin and the Hueco Bolson. The youngest fault displacements that rupture the surface probably occurred 1,000 years ago along the north-trending Organ Mountains fault (Gile 1987, 1994). A single-event surface rupture of almost 10 feet is reported (Collins and Raney 1991) to have occurred during the Pleistocene along the east side of the Franklin Mountains. The dip of this fault ranges from vertical to 60 degrees east (Lovejoy and Hawley 1978).

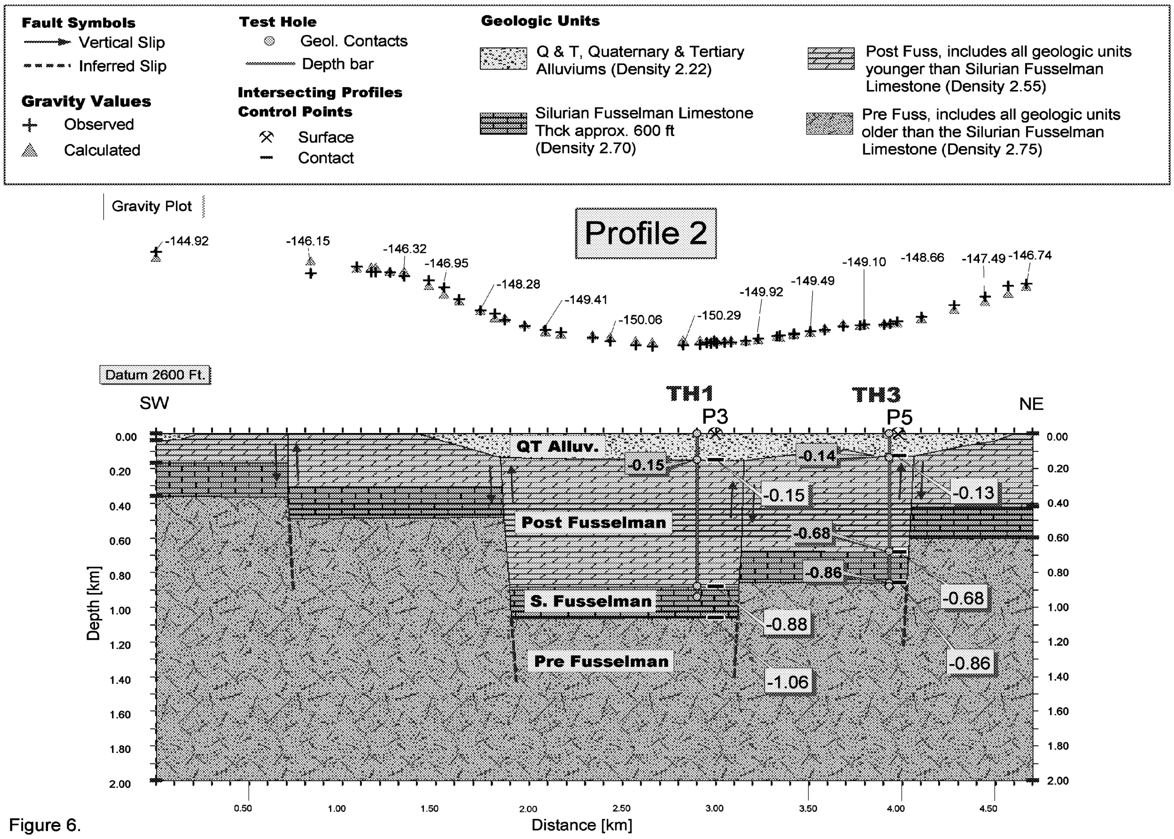
3.1.2 Geologic Hazards

Between 1847 and 2001, the residents of El Paso experienced eight earthquakes. The 1931 Valentine earthquake is the largest known earthquake in Texas, and it caused severe damage in the epicentral region (Davis et al. 1989). The epicenter is approximately 150 miles southeast of El Paso. Smaller earthquakes have struck the El Paso-Juárez area in 1889, 1923, 1931, 1936, 1937, 1969, and 1972. The 1923 earthquake was felt throughout a large region, but the strongest shaking was in El Paso and Juárez (Davis et al. 1989). The 1937, 1969, and 1972 earthquakes were felt more strongly on the east side of El Paso than on the west side. According to some, earthquakes in the west Texas region are related to a zone of crustal weakness, referred to as the Texas Lineament, that extends at least as far west as southern Nevada (Muehlberger 1980; Drewes 1978).



Source: Hutchison and Granillo 2004a

Figure 3-2. Location of Stratigraphic Profile 2 (see Figure 3-3)



Source: Hutchison and Granillo 2004a

Figure 3-3. Interpreted Stratigraphy Along Profile 2

According to Sanford et al. (1972), an earthquake of magnitude 6 can be expected every 100 years in the Rio Grande Rift, particularly in that part of the rift from Socorro to Albuquerque. This estimate is based largely on the region's earthquake record, which now extends back about 150 years. However, the historic pattern of earthquakes in the western U.S. is episodic; areas can apparently remain inactive for tens to thousands of years and then suddenly be struck by swarms of earthquakes (Smith 1978).

Gile (1994) recognizes an episodic pattern of displacement along the Organ Mountains fault. This fault ruptured about 1,000 years ago and has an estimated rupture-recurrence interval of 4,000 to more than 5,000 years (Gile 1994; Machette 1987). If this fault is continuous northward with the fault along the east base of the San Andres Mountains and southward with the fault along the east base of the Franklin Mountains, then it is more than 100 miles long. A rupture along the entire length of this fault could exceed a magnitude of 6 and cause widespread, severe damage to human-made structures in west Texas and south-central New Mexico.

3.1.3 Geologic Resources

3.1.3.1 Mineral Resources

Figure 3-4 shows the location of mining districts, quarries, geothermal areas, and exploration holes for oil and gas in the Fort Bliss area. Industrial minerals and materials are currently produced from numerous quarries in the Fort Bliss area. Large amounts of sand, gravel, and building stone are available throughout the Tularosa Basin and Hueco Bolson, as is limestone from Paleozoic rocks in neighboring mountains and mesas.

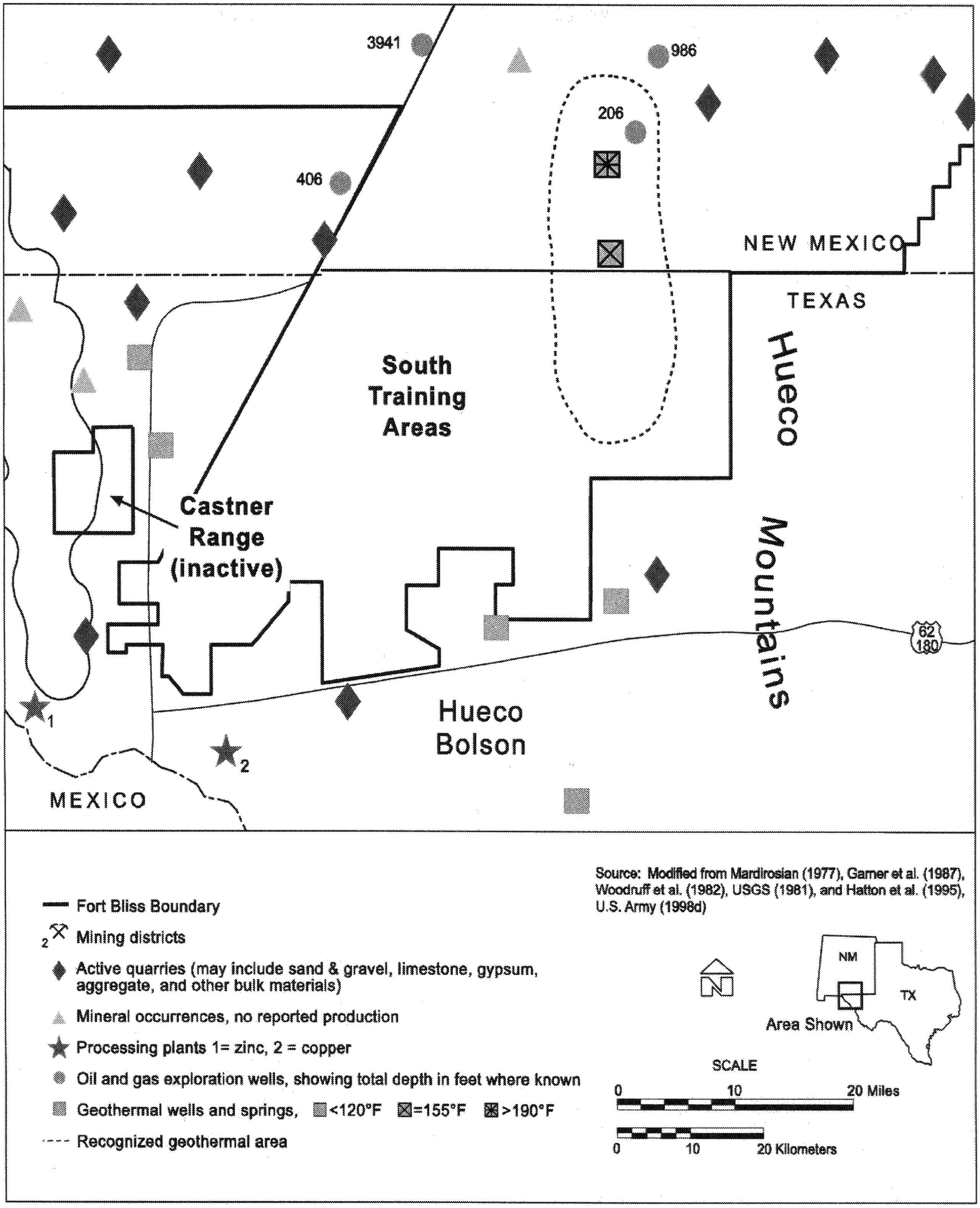


Figure 3-4. Mineral and Energy Resources in the Fort Bliss Area

3.1.3.2 Geothermal Resources

Geothermal resources of commercial proportion (generally hotter than 194 °F and capable of generating commercial amounts of electricity) are most prevalent in areas of crustal instability, high heat flow, and young igneous rocks (Muffler 1979). In contrast, low-temperature geothermal resources (under 194 °F) occur widely, apparently originating from deep groundwater circulation in regions with normal or higher-than-normal geothermal gradients. The Rio Grande Rift is characterized by crustal instability, moderate to high heat flow, and warm to hot subsurface waters.

Studies indicate that a heat-flow anomaly is present in the McGregor Range (Witcher 1997). The heat flow in the center of the anomaly is seven times higher than background temperatures. The center of the anomaly is approximately 3 miles wide and 11 miles long, but elevated temperatures cover more than 25 miles, extending south into Texas (see Figure 3-3). Water temperatures within the 25-mile-long geothermal area range from 176 to 230 °F (Henry and Gluck 1981). The temperature of the water from the slimholes at the potential concentrate injection site was measured at less than 100 °F (TetraTech/NUS 2003). This indicates that the potential injection site is either on the fringe of the geothermal area or completely separated from it.

The Army has investigated the potential of the geothermal area to supply electricity for operations at Fort Bliss near Davis Dome, where temperatures up to 192.4 °F have been recorded. With current technology, however, the potential of this resource is not realizable, and the Army is not currently pursuing its use. Other parts of Fort Bliss have the potential for low to moderate temperature geothermal waters that could be used locally for space heating.

3.1.3.3 Oil and Gas Resources

Formations in the Tularosa Basin suggest there could be potential reserves of oil and gas resources (King and Harder 1985). Through 1980, oil and gas exploration wells had been drilled in the Fort Bliss area (see Figure 3-3), but all were dry (USGS 1981). Foster (1978) lists the wells that showed noncommercial volumes of oil and gas. The most successful test wells were drilled in 1974 at the northern end of the Tularosa Basin near Three Rivers, where noncommercial volumes of natural gas were recovered (King and Harder 1985). Testing for oil and gas resources has been limited and generally unsuccessful. The overall geologic history of south-central New Mexico and west Texas is not particularly favorable for the preservation of sizeable accumulations of oil and gas (Thompson 1976). If oil and gas resources exist in this region, they are likely to be very small (fewer than 10 million barrels of recoverable oil or 60 billion cubic feet of recoverable gas).

3.1.3.4 Uranium

Although uranium can occur in a variety of geologic environments, sandstone of Jurassic age has been the most prolific source (Chenoweth 1976). Jurassic rocks do not occur in south-central New Mexico or west Texas. Uranium minerals have been reported from several areas at and near Fort Bliss. The potential to develop commercial quantities of uranium at these sites, or elsewhere in the region, is relatively low.

3.1.4 Soils

Figure 3-5 shows the distribution of soil types in the project area. The latest soil map and attribute data were downloaded from the Soil Survey Geographic Database for Fort Bliss Military Reservation, New Mexico and Texas (NRCS 2002).

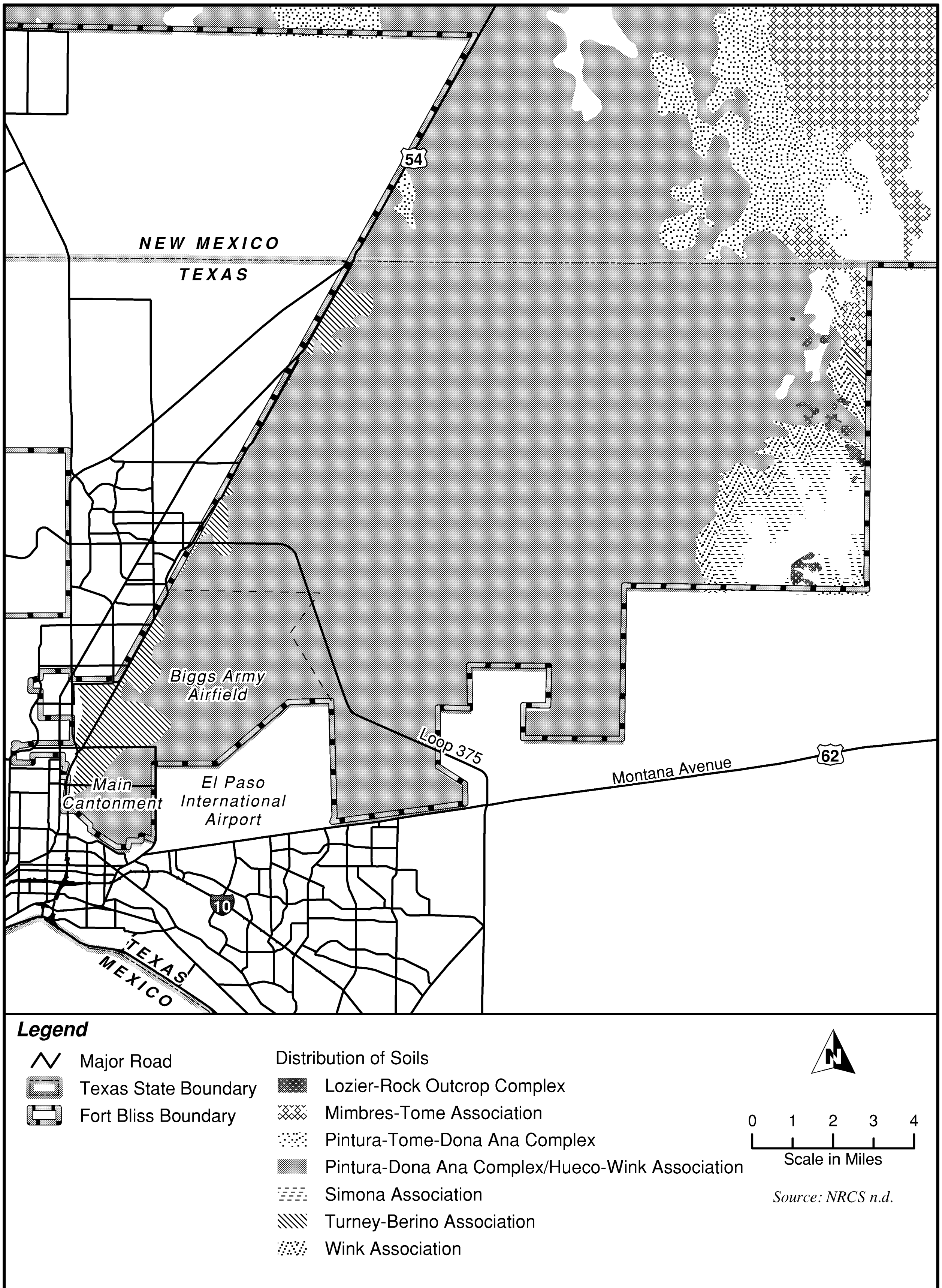


Figure 3-5. Distribution of Soil Units in the Desalination Plant Project Area

The majority of soils in the southeast Fort Bliss area are classified as either aridisols or entisols. Aridisols are soils with well-developed soil horizons that developed under conditions of low moisture. Little water leaches through the profile (Donahue et al. 1977). Consequently, some of these soils have lime-cemented hardpans (caliche). Entisols, young soils with little or no development of soil horizons, are located in areas where the soil is actively eroding or receiving new deposits of soil materials (such as alluvial fans, floodplains, and windblown sand dunes).

Soils in the southeast Fort Bliss area generally consist of sandy, silty, and gravelly loams, and fine sands and silts. The soils are alkaline and calcareous, having developed from the weathering of gypsum, sandstone, and limestone, and igneous and metamorphic rocks. Windblown sediments widely occur from exposed lakebeds. Wind is an important soil-forming agent in the Fort Bliss area. Windblown sand is common, with the greatest accumulations in the basins, often forming dunes.

The soils of the Fort Bliss area can be separated into two general categories based upon the following physiographic positions: (1) valleys and basin floors; and (2) mountains, mountain foot slopes, and steep slopes formed by erosion. Soils in valleys and basins are shallow to deep, nearly level to very steep, and well drained to excessively drained. These soils formed in alluvium, alluvium modified by wind, and eolian material (USDA 1971, 1980, 1981). Most of the basin floors are covered by coppice dunes (windblown deposits trapped by mesquite thickets) and windblown sheet deposits. These soils are found mainly in the Tularosa Basin and Hueco Bolson.

Major soil units in the area are combinations of soil associations and series that are described in greater detail in **Appendix E,** which summarizes textural, geomorphic, hydrologic, and geographic features of the soil series. The dominant soils are Copia, McNew, and Pendero series. Soils in valleys and basins are used mainly for grazing, wildlife habitat, and watershed. Disturbance of the soil may come from construction, wheeled and tracked vehicle maneuvering, and facilities that may release fluids into soil.

Wind and water erosion are currently the most significant processes affecting soils in the Fort Bliss area. Soils unprotected by vegetation are susceptible to erosion from wind and water runoff. Gullying is the most prevalent form of erosion, but sheet and rill erosion caused by water and wind are processes that can also significantly affect soil movement.

Erodibility of soils varies considerably across the Fort Bliss area. In general, soil erodibility is a function of soil type, slope, and vegetative cover. Sandy soils are extremely wind erodible (USDA 1981). Loamy sands are highly erodible and capable of supporting a protective vegetative cover. Soils with large amounts of clay are moderately erodible when undisturbed; however, when these soils are substantially disturbed, they become highly erodible and a possible source of particulate matter less than 10 micrometers in diameter (PM_{10}). Loamy soils with less than 35 percent clay are slightly erodible, and stony or gravelly soils and rock outcrops are not generally subject to erosion.

Soils in the coppice dunes area of the Tularosa Basin are subject to wind erosion. The acceleration of these erodible dunes is caused by a breakdown of surface crusts on the soils between dunes, caused in part by the maneuvering of tracked vehicles (Marston 1984).

Most of the soil movement in this area is localized from dune to dune, but on windy days blowing dust particles rise to the atmosphere (BLM 1988). Within the Tularosa Basin, roads have been constructed in the training areas in such a manner that they have become channels for rainwater runoff and have caused considerable erosion (BLM 1988).

3.2 WATER RESOURCES

This section addresses surface and groundwater resources in the project area and specifically in the Hueco Bolson. The ROI for water resources includes the surface water and groundwater sources from which EPWU and Fort Bliss obtain water to supply their users.

Aquifers occurring along the Rio Grande near El Paso (**Figure 3-6**) are in the southeastern portion of the Southwest Alluvial Basins aquifer system (Wilkins 1998) within the Basin and Range Physiographic Province. The Mesilla and Tularosa-Hueco basins occur in the El Paso region. The basin valleys (bolsons) are filled with thick sediment that has eroded from the adjacent highlands or resulted from deposition by the Rio Grande. The El Paso area lies predominantly within the upper Hueco Bolson, but also derives water from the Mesilla Bolson and the Rio Grande. The Rio Grande aquifer system in Texas is associated with laterally extensive sediments deposited by the Rio Grande, with alluvial aquifers occurring in Culberson, El Paso, Hudspeth, Jeff Davis, and Presidio counties.

3.2.1 Surface Water

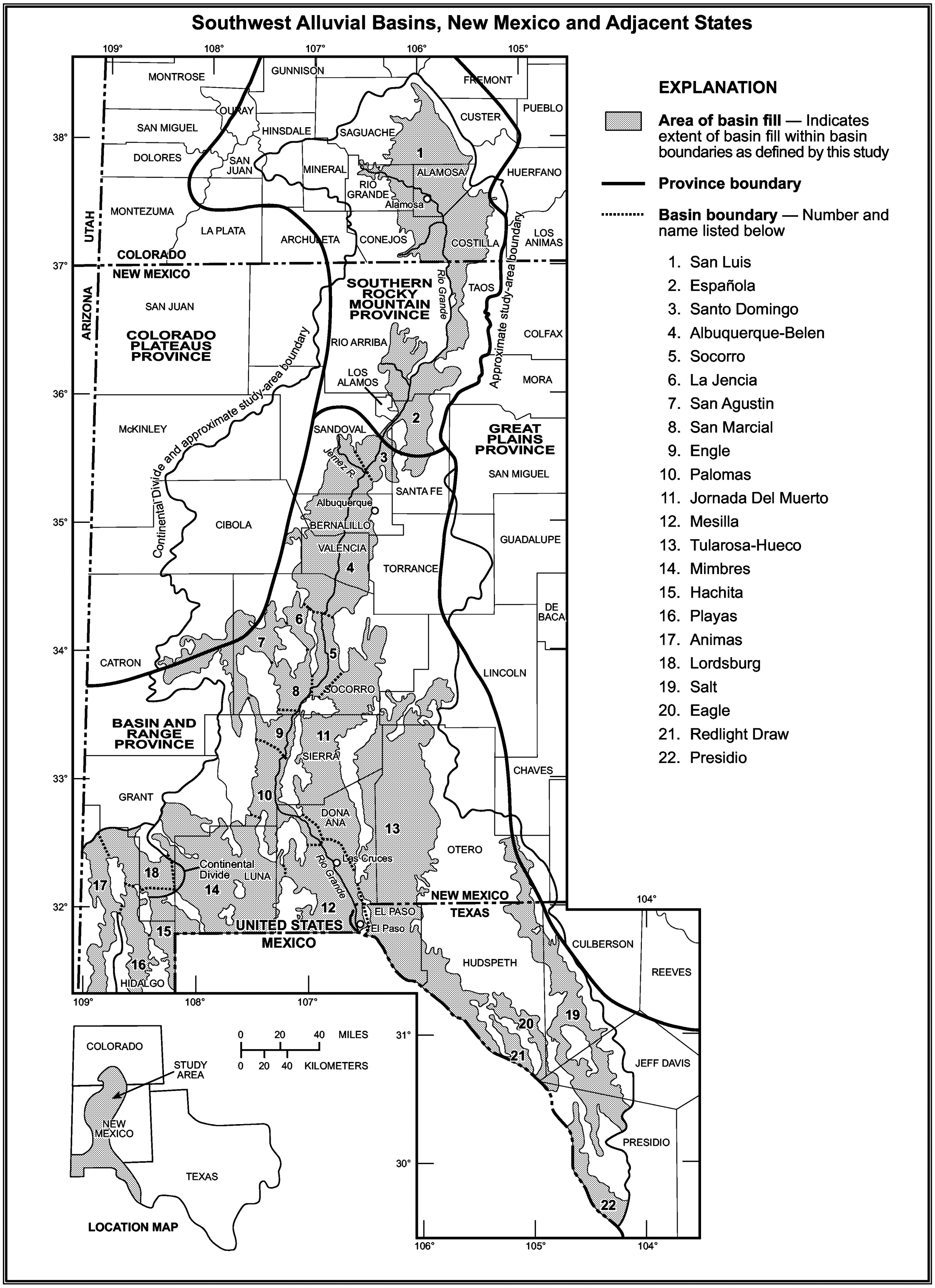
The Rio Grande is the only usable source of surface water in the El Paso area. Municipal and industrial supplies of Rio Grande Project water are obtained by the City of El Paso conversion of agricultural water to municipal and industrial use under the Reclamation Act of 1920. Various contracts executed under the 1920 Act among the City, the El Paso County Water Improvement District, and the U.S. Bureau of Reclamation have authorized conversion of water rights to municipal and industrial use through purchases of land with Rio Grande Project water rights, leases of rights to water from lands with Rio Grande Project water rights, and conversion of conserved water from the lining of canals. Surface water is preferred by farmers for irrigation because of its lower cost. However, during years of inadequate surface water supply, shallow wells in the Rio Grande alluvium are pumped by farmers to augment Rio Grande water. The El Paso region obtained an average of 76 percent of its water supply from intermontane-basin aquifers in the Hueco and Mesilla Bolsons and the remaining 24 percent from the Rio Grande between 1967 and 2002 (EPWU 2003a). The maximum annual surface water production of 58,743 AF occurred in 2002 and comprised approximately 49 percent of the total water production for that year (**Table 3-1**).

Reuse of river water for irrigation between the headwaters and El Paso degrades the quality of the water by increasing its dissolved solids content. During periods of high reservoir releases, the water quality meets drinking water standards, and El Paso can use the water after conventional treatment. However, during periods of low discharge, including the nonirrigation season (October-March) and during droughts, the salinity increases to the point that the water is no longer usable for domestic purposes (Walton and Ohlmacher 2000).

3.2.2 Groundwater

EPWU obtains groundwater primarily from the Hueco Bolson; some groundwater is obtained from the Mesilla aquifer and would not be affected by the proposed action and alternatives.

The majority of the freshwater (chloride less than 250 mg/l) in the Hueco Bolson Aquifer lies along the eastern front of the Franklin Mountains (Hutchison 2004). A series of maps indicating the area of freshwater at various depths in the basin shows that the thickest part of the aquifer underlies Fort Bliss, northeastern El Paso, and northern Mexico. The freshwater portion of the aquifer is more than 1,000 feet deep in this area. The freshwater zone is widest at or near the water table and narrows with depth (Hutchison 2004).



Source: Modified from Wilkins 1986

Figure 3-6. Location of Southwest Alluvial Basins, Basin Boundaries, and Physiographic Provinces

Table 3-1. EPWU Water Production from 1983 to 2002

Year	Surface Water Production from the Rio Grande (acre-feet)	Total Water (acre-feet)	Rio Grande Production As a Percent of Total
1983	22,419	105,045	21
1984	20,769	104,058	20
1985	22,423	108,565	21
1986	25,588	109,186	23
1987	22,378	117,014	19
1988	23,448	117,359	20
1989	25,674	125,215	21
1990	29,812	119,064	25
1991	28,153	112,294	25
1992	40,810	122,731	33
1993	50,868	123,709	41
1994	58,667	132,380	44
1995	56,060	129,885	43
1996	46,219	128,948	36
1997	54,194	127,837	42
1998	57,794	131,700	44
1999	57,879	131,142	44
2000	42,329	126,421	33
2001	48,428	122,689	39
2002	58,743	120,485	49

Source: EPWU 2003b.

Small areas of freshwater in the eastern portion of the Hueco aquifer are surrounded by slightly to moderately saline water. The area of freshwater thins toward the east until only brackish water is present. Small pockets of freshwater occur along the base of the Hueco Mountains and serve as a water supply for commercial and residential users. In addition to fresh groundwater in storage, large volumes of brackish water are stored within deeper bolson sediments (Hutchison 2004).

Computer simulation of groundwater flow and salinity indicates that the greatest potential for saline contamination of freshwater zones is from the horizontal movement of saline water at or near the water table rather than from vertical migration (Groschen 1994). Saline water in the Rio Grande alluvium and from irrigation return flow represents the greatest potential for saline contamination of freshwater (Groschen 1994).

Estimates of groundwater availability representing the amount of usable water in the Hueco Bolson Aquifer in Texas are varied (**Table 3-2**). Groundwater availability estimates are an ongoing component of aquifer management and include assessments of recoverable freshwater and increasingly include assessments of slightly saline resources. Estimates of freshwater availability range from 3 million AF to 10.6 million AF (Sheng et al. 2001; Hutchison 2004). Estimates of the availability of slightly saline (between 1,000 and 3,000 mg/l TDS) are more uncertain, ranging from 2.5 to 20 million AF (Sheng et al. 2001). EPWU has developed an estimate of groundwater storage in the Hueco Bolson based on recent data obtained from drilling, groundwater quality profiles, and shallow well water quality analyses (Hutchison 2004). These are included in Table 3-2.

Additional information about groundwater in the Hueco Bolson is provided in **Appendix F**.

Table 3-2. Estimates of Groundwater Availability in Texas Hueco Bolson Aquifer

Freshwater* (million AF)	Saline Water** (million AF)	Total (million AF)	Source
7.4	Not estimated	7.4	Knowles and Kennedy 1958
10.6	Not estimated	10.6	Meyer 1976
10	Not estimated	10	White 1983
9	Not estimated	9	Texas Water Development Board 1997
3	20	23	Sheng et al. 2001
3	2.5	5.5	Far West Texas Planning Group 2001
9.4***	16.9***	26.3	Hutchison 2004

AF acre-feet
mg/l milligrams per liter
TDS Total Dissolved Solids

* Freshwater is water with less than 1,000 mg/l TDS.
** Saline water is water with more than 1,000 to less than 3,000 mg/l TDS.
*** Freshwater defined as water with less than 250 mg/l chloride and saline water as greater than 250 up to 1,000 mg/l.

Source: Sheng et al. 2001; Hutchison 2004

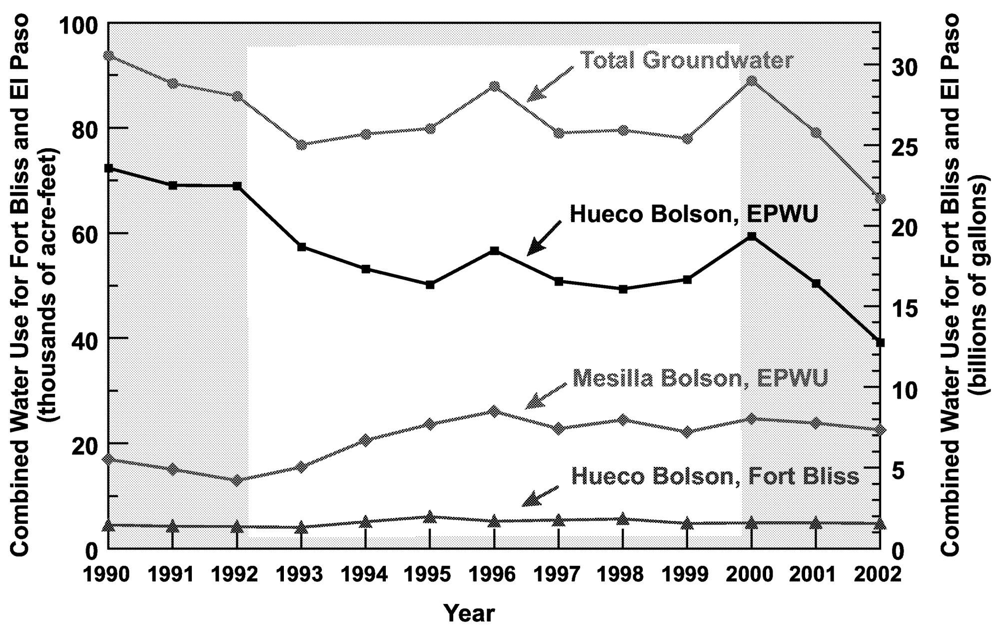
Groundwater Usage in Hueco Bolson Aquifer

In 2002, 84 wells in the Hueco Bolson Aquifer were operated by EPWU, producing 117 MGD. The majority of the production came from the Mesa-Nevins and Airport Wellfields (EPWU 2003a). The rate of groundwater pumping from the aquifer currently exceeds the recharge rate, creating water level decline (Cushing 1996). The largest declines have occurred adjacent to the municipal well fields. Rates of water level decline in the metropolitan El Paso area range from less than 0.5 feet per year in the east to more than 5 feet per year near pumping centers (White 1983). Historically, from 1903 through 1989, declines of as much as 150 feet have occurred in the downtown areas of El Paso and Ciudad Juárez. Declines of more than 50 feet occurred in the same general area during the 10-year period between 1979 and 1989 (Ashworth 1990).

Over the past decade, combined water use by the city and the installation averaged approximately 133,000 AF per year (43 billion gallons per year) (Hutchison and Maxwell 2004). On average, approximately 60 percent of the total annual water used by Fort Bliss and the city combined was drawn from freshwater supplies in the Hueco Bolson and Mesilla Bolson aquifers (**Figure 3-7**). That percentage has declined since 2000 due to EPWU's increased use of the Rio Grande as a source of drinking water, aggressive conservation, emphasis on reclaimed water, and effluent exchange agreements.

In spite of a steadily increasing population, water use in the El Paso area has remained relatively constant since about 1994. The city uses water conservation and reclamation to reduce demands on fresh water supplies in the El Paso area (EPWU 2003b). Water conservation programs have been successful in reducing per capita water consumption from approximately 180 gallons per day in 1994 to 153 gallons per day in 2002. The goal of the city's water conservation efforts is to reduce per capita water consumption to 140 gallons per day by 2010.

As indicated in Figure 3-7, during the past decade, most of the groundwater used by EPWU and Fort Bliss has been drawn from freshwater stored in the Hueco Bolson Aquifer (Hutchison and Maxwell 2004; Rodriguez 2003). The bolson provided approximately 72 percent of the total groundwater and 46 percent of the total combined water used by the installation and the city since 1993. Fort Bliss withdrawals of freshwater from the bolson have averaged approximately 5,000 AF per year (1.6 billion gallons per year) and remained relatively constant.



Source: Hutchison and Maxwell 2004; Rodriguez 2003

Figure 3-7. Groundwater Use by the City of El Paso and Fort Bliss Since 1990

3.3 UTILITIES AND SERVICES

Resources discussed in this section include potable water pumping and distribution; wastewater collection and treatment; solid waste collection and disposal; and power generation and distribution. The section does not address those utilities and services such as storm water management and natural gas distribution that would not affect or be affected by the proposed action and alternatives. The ROI for assessing utility systems includes the service areas of EPWU and the El Paso Electric Company.

3.3.1 Potable Water Systems

Water supplies in the vicinity of Fort Bliss and the City of El Paso are obtained from aquifers in the Hueco and Mesilla Bolsons and from the Rio Grande and alluvium. The Hueco and Mesilla Bolsons groundwater sources are described in Water Resources (Section 3.2). The Rio Grande provides a substantial source of potable water to the region.

Surface water resources in this border area are managed by the International Boundary and Water Commission. This commission applies rights and obligations that the governments of the U.S. and Mexico assume under numerous boundary and water treaties and related agreements. These rights and obligations are applied in ways that benefit the social and economic welfare of the peoples on each side of the border and improve relations between the two countries.

Water from the Rio Grande is administered under a U.S. Bureau of Reclamation irrigation project that regulates the flow of the Rio Grande below Elephant Butte Reservoir in New Mexico. The reservoir stores and releases water as necessary to meet power generation needs in the region. Caballo Reservoir, downstream of Elephant Butte Reservoir, regulates releases to meet downstream demands through the January to October irrigation season. Five diversion dams on the river direct flows to the Elephant Butte Irrigation District, New Mexico; the El Paso County Water Improvement District #1 (EPCWID) Texas; and to Mexico (Cushing 1996).

The Rio Grande Compact Commission provides for full releases of 790,000 AF per year to the irrigation districts, including 60,000 AF per year to Mexico. The full EPCWID allotment is 43 percent of the available U.S. project water, or about 310,000 AF per year (El Paso County 1992). Return flows and other water entering the system below Caballo Reservoir increase the amount delivered to EPCWID to about 360,000 AF per year. In years when Rio Grande flows are below full allotment, less than full allotments are released, and the deliveries are decreased proportionately. Provisions of the agreement allow Colorado and New Mexico to incur debits in their deliveries to Texas and to cancel accrued debits when reservoir spills occur during years of high flow (Cushing 1996). Currently, almost all of the agricultural production in El Paso County occurs within the irrigated area of the EPCWID and areas contiguous to the district that irrigate with groundwater.

EPWU currently operates 152 wells, 57 reservoirs, 45 booster pump stations, two surface water treatment plants with a combined capacity of 100 MGD, and over 2,100 miles of pipelines servicing the El Paso area (**Figure 3-8**). The Robertson/Umbenhauer surface water treatment plant, originally built in 1943, is centrally located within the city and has a capacity of 40 MGD. The Jonathan W. Rogers surface water treatment plant started production in early 1993. It is located to serve the city's east side and lower valley area. Together they produce about 56 percent of total daily demand. The Jonathan W. Rogers surface water treatment plant is currently expanding to increase capacity to 60 MGD. Following expansion, the utility's total surface water supply capability will be 100 MGD, which will be more than 50 percent of the total projected annual demand. Currently, the surface water treatment plants operate at full capacity seven to eight months of the year.

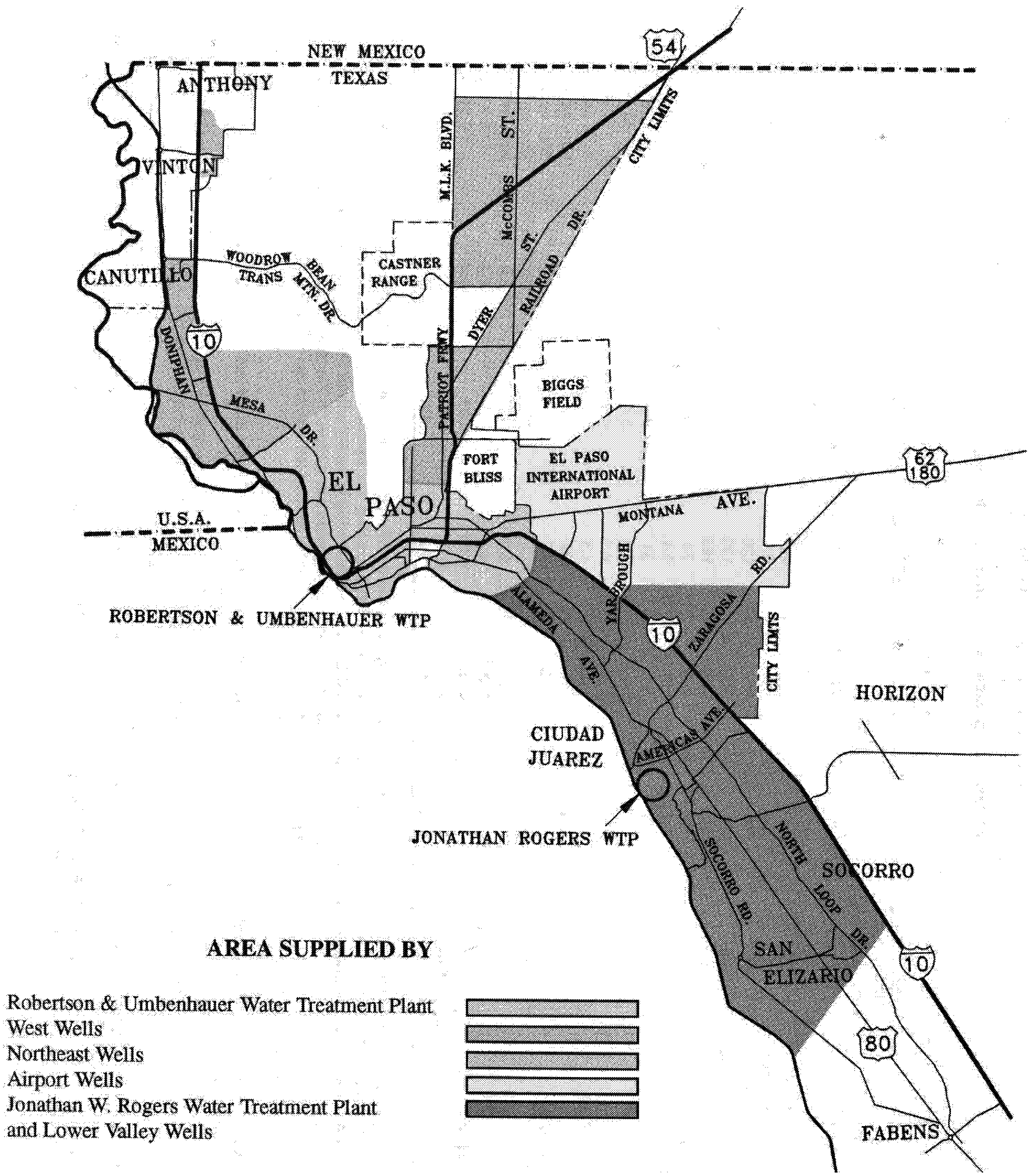
Projected water demand for municipal and nonmunicipal uses in El Paso County ranges from 414,700 AF in 2010 to 501,043 AF in the year 2060 (TWDB 2003). The projections for municipal water demand are based on population trends and per-capita water usage. Projections for nonmunicipal water demand are based largely on state survey data. Based on population projections and year 2000 per-capita water use, water demand for Fort Bliss is projected to remain relatively flat at 7,773 AF in 2010 to 7,607 AF in 2060 (TWDB 2003). Projected municipal and nonmunicipal water the El Paso region is summarized in **Table 3-3**.

Potable water is provided to the Main Cantonment at Fort Bliss from two separate well fields that obtain fresh groundwater from the Hueco Bolson Aquifer. The Main Post has 11 wells with a total capacity of 16.27 MGD, and Biggs AAF has 2 wells with a total capacity of 2.88 MGD. The combined capacity of these wells is 19.15 MGD. Fort Bliss also obtains potable water for the Main Cantonment from EPWU through multiple connections to the utility's water supply system. Agreements as of December 2000 guarantee a 4.25 MGD supply for the post from EPWU. Total potable water consumption at the post in 2000 was approximately 5.05 MGD, with 0.49 MGD coming from the EPWU (U.S. Army 2000).

3.3.2 Wastewater Systems

The City of El Paso has four wastewater treatment plants managed by EPWU. The Quarry (Northwest) Wastewater Treatment Plant can treat approximately 17.5 MGD of wastewater from residential and industrial sources in the west and northwest parts of the city and is permitted (TCEQ Permit No.

WQ0010408-009) to discharge to a tributary of the Rio Grande. Much of the treated effluent is used in the NW Wastewater Reclamation Facilities Project (EPWU-PSB 2003a).



Source: EPWU

Figure 3-8. Potable Water Service Area of the El Paso Water Utilities

Table 3-3. Projected Water Demand for El Paso County

Use	Water Demand Projections (in acre-feet)					
	2010	2020	2030	2040	2050	2060
Non-Municipal						
Livestock	780	780	780	780	780	780
Steam/Electric	3,131	6,937	8,111	9,541	11,284	13,410
Irrigation	248,264	243,931	241,972	233,465	229,646	225,890
Mining	157	153	151	149	147	146
Manufacturing	9,181	9,994	10,692	11,367	11,941	12,855
Subtotal	**261,513**	**261,795**	**261,706**	**255,302**	**253,798**	**253,081**
Municipal						
Subtotal	**153,187**	**175,602**	**195,010**	**211,581**	**229,092**	**247,962**
Total	**414,700**	**437,397**	**456,716**	**466,883**	**482,890**	**501,043**

Source: Texas Water Development Board 2003

The FHWRP treats approximately 10 MGD of wastewater from the northeast part of the city. The water from this plant is completely reclaimed and distributed to the Painted Dunes Municipal Golf Course for irrigation, to the El Paso Electric Company Newman Generation Plant for use as cooling tower water, and to the Hueco Bolson (TCEQ Permit No. WQ0010408-007) to help recharge the aquifer (EPWU-PSB 2003a).

The Haskell R. Street Wastewater Treatment Plant serves the central part of the city and currently has a treatment capacity of 27.7 MGD. The plant is permitted (TCEQ Permit No. WQ0010408-004) to discharge to either the Rio Grande or the American Canal. The preferred discharge point is to the American Canal in order to provide irrigation water to farmers in the Lower Valley. In exchange for this irrigation water, the EPWU obtains valuable water credits for surface water that is treated to provide drinking water, thus reducing El Paso’s dependence on groundwater supplies from the Hueco and Mesilla Bolsons (EPWU-PSB 2003a).

The Roberto R. Bustamante Wastewater Treatment Plant serves the city’s east and southeast areas, and the Lower Valley area. The plant has a treatment capacity of 39 MGD and is permitted (TCEQ Permit No. WQ0010408-010) to discharge to either the Riverside Canal or the Riverside Drain. Discharges to the Riverside Canal are used chiefly for irrigation purposes. Discharges to the Riverside Drain go mainly to the Rio Bosque Wetlands Preserve where they help maintain and sustain the aquatic habitat required by the diverse animal and plant species present. The plant also has the capability to provide reclaimed water to industries located in the Riverside Industrial Park (EPWU-PSB 2003a).

Wastewater generated at the Fort Bliss Main Cantonment flows to the City of El Paso’s sanitary sewer system operated by EPWU. Wastewater generated at four Site Monitor buildings located in the South Training Areas is collected in septic tanks that flow to drain fields or dry wells. Wastewater generated at EPIA is collected by the city of El Paso’ sanitary sewer system.

3.3.3 Solid Waste Systems

The city owns and operates two Type I Landfills (TCEQ Acct. No. EE-2213-K) that are governed under TCEQ and U.S. Environmental Protection Agency (USEPA) Rules and Regulations – the Clint Landfill (MSW ID Nos. 1482 & 2284) and McCombs Landfill (MSW ID Nos. 1541 & 729A, PST Facility ID No. 64363). Institutional, commercial, or multi-family residential garbage collection is provided. Any business, institution, or agency that collects, removes, transports, or disposes of any solid waste to the city landfill must annually register with the city. The Clint Landfill No. 1482 has a remaining life expectancy of approximately 15 months and is only accepting waste from residents who bring it to the site. It is being replaced by Clint Landfill No. 2284, expected to open in August 2004, which is designed with a 30-year life expectancy at the current daily solid waste accumulation rate of 800 tons per day (tpd) (Adams 2003, 2004). The McCombs Landfill has a remaining life expectancy of less than 6 months and is only accepting waste from residents and commercial paying customers (Adams 2004).

Fort Bliss is the registered owner/operator of a Type I/IV landfill (MSW ID No. 1422) located 3 miles north of the intersection of Fred Wilson and Chaffee roads. Domestic solid waste (refuse) and construction debris are collected separately from all Fort Bliss locations in Texas and disposed of by individual contractors.

3.3.4 Electrical Services and Distribution

The El Paso Electric Company operates three generating stations in the El Paso area, including the Newman, Rio Grande, and Copper power stations (**Figure 3-9**). The power company also has acquired entitlements to a portion of the power from Arizona's Palo Verde Nuclear Generation Station, and entitlements to coal generated power from the New Mexico Four Corners power station (City of El Paso 2003). As of FY 2000, the power company had a net installed generating capacity of approximately 1,500 megawatts in the El Paso area (U.S. Army 2000).

Electric power is distributed to the city of El Paso by the El Paso Electric Company, which operates a 115-kilovolt transmission loop system in the region that provides service to Fort Bliss, the EPIA, and the surrounding areas including southern New Mexico, El Paso County, and other points in West Texas (U.S. Army 2000).

A dedicated 50-MVA substation located near the intersection of Jeb Stuart and Chaffee roads currently supplies the Fort Bliss Main Cantonment Area (U.S. Army 2000). Biggs AAF receives power from the Butterfield-14 substation (Roman 2003). The Scottsdale-13 substation powers the EPIA facilities, exclusive of the radar tower. The Vista-13 substation provides power to the Site Monitor Location. There are several redundant substations supplying the airport radar tower, primarily from the Scottsdale and Vista locations. There is also a redundant substation at the Butterfield location, which could provide a backup supply to Biggs AAF. The other major customers serviced by the Butterfield location include El Paso Natural Gas Hangar Facility and American Hospital Supply. There are three 14-kilovolt substations that have been identified in the vicinity of the Airport Wells with surplus capacity: Butterfield-11, Scottsdale-14, and Vista-13 (Gonzales 2003).

3.4 HAZARDOUS MATERIALS, HAZARDOUS WASTE, AND SAFETY

Hazardous Materials and Waste

Hazardous materials are defined under the Occupational Safety and Health Act (OSHA), the Solid Waste Disposal Act (SWDA), the Comprehensive Environmental Restoration, Compensation and Liability Act (CERCLA), and the Emergency Planning and Community Right-to-Know Act (EPCRA). Hazardous materials are generally defined as any substance that, due to quantity, concentration, physical, chemical, or infectious characteristic, may present substantial danger to worker safety, public health, welfare, or the environment.

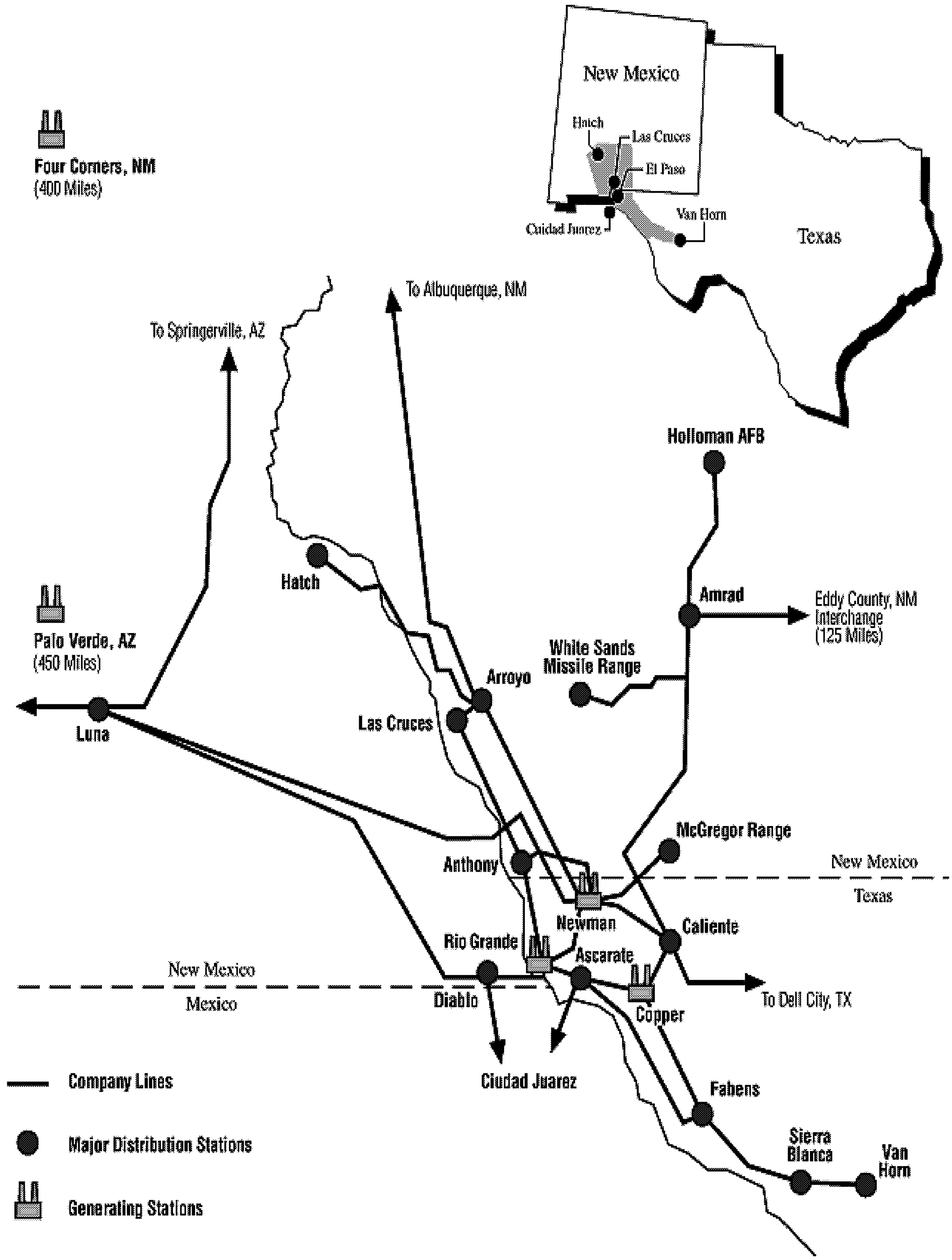


Figure 3-9. El Paso Electric Service Area

Hazardous materials are regulated by OSHA and the Texas Department of Health. Management of hazardous materials in the State of Texas is defined by the following chapters of Title 6 of the Texas Health and Safety Code: 501 (Hazardous Substances), 502 (Hazard Communication Act), 503 (Health Risk Assessment of Toxic Substances and Harmful Physical Agents), 504 (Anhydrous Ammonia), 505 (Manufacturing Facility Community Right-to Know Act), 506 (Public Employer Community Right-to Know Act), 507 (Nonmanufacturing Facilities Community Right-to Know Act), and 508 (Area Quarantine for Environmental or Toxic Agent).

Hazardous waste is defined under RCRA (40 CFR 261.3) as any solid, liquid, contained gaseous, or semi-solid waste, or any combination of wastes, that either (1) exhibits one or more of the hazardous characteristics of ignitability, corrosivity, toxicity, or reactivity (as defined by 40 CFR 261 subpart C), or (2) is listed as a hazardous waste under 40 CFR Part 261 subpart C (RCRA, Determining Solid and Hazardous Wastes).

Hazardous wastes are regulated by USEPA and TCEQ. Management of hazardous wastes in the state of Texas is defined by the following chapters of Title 30 of the Texas Administrative Code (30 TAC): 335 (Industrial Solid Waste and Municipal Hazardous Waste), 334 (Petroleum Storage Tanks), 327 (Spill Prevention and Control), 350 (Texas Risk Reduction Program), 333 (Voluntary Cleanup Program); and by Texas Health and Safety Code chapter 361.

The ROI for hazardous materials and waste includes the area southeast of Biggs AAF and at the east end of the EPIA; the vicinity of the FHWRP; and the proposed concentrate deep-well injection area, close to the Texas-New Mexico border.

Safety

Safety includes ground safety and flight safety. Ground safety considers risks to personnel, the public, and property. Flight safety considers risks to aircraft flight. Personnel safety is regulated primarily by the OSHA and attendant regulations. Flight safety is regulated by the Federal Aviation Administration (FAA), for civil airports and airspace, and the Department of Defense (DOD), for military airports.

Executive Order 13045, Protection of Children From Environmental Health Risks and Safety Risks requires that each federal agency identify and assess environmental health risks and safety risks that may disproportionately affect children, and address such risks in their policies, programs, activities, and standards.

The ROI for safety includes the proposed project sites and surrounding areas that may be exposed to ground safety risks, and flight operations at Biggs AAF and EPIA.

3.4.1 Hazardous Materials

There are three facilities near the site of the proposed desalination plant that use hazardous materials: Fort Bliss and Biggs AAF, EPIA, and FHWRP.

A wide range of hazardous chemicals is used by Fort Bliss. These include explosives, paints, cleaners, photographic chemicals, pesticides, and herbicides.

The primary hazardous chemicals used by Biggs AAF and EPIA are jet fuel and deicer. Both of these materials are used in high volumes. Materials used in small volumes include paints, solvents, cleaners, and pesticides.

EPWU uses a wide variety of hazardous chemicals similar to those that would be used at the desalination plant at its potable water treatment plants. Ozone (on-site generation), ferric chloride, polymers used for solids coagulation, chlorine for disinfection, and granular activated carbon, used for removal of dissolved hydrocarbons or chlorine disinfection by-products, are all commonly used materials (Balliew 2003).

The FHWRP is a 10 MGD wastewater treatment facility that treats municipal sewage to drinking water standards. The primary hazardous material used at the plant is chlorine, which is used to disinfect the final effluent before it is either injected into the Hueco Bolson Aquifer or sold to commercial customers. Other potentially hazardous materials used include coagulants to assist in settling solids from the wastestream, and acids or bases (as required) to adjust the pH of the wastewater to maximize treatment efficiency.

No hazardous materials are currently used at the proposed deep-well injection site.

3.4.2 Hazardous Wastes

Fort Bliss generates hazardous waste at over 130 sites throughout the installation in accordance with an existing RCRA-C Part B permit.

Information regarding hazardous wastes sites at Fort Bliss was obtained from the most recent update of the Fort Bliss Installation Action Plan (U.S. Army 2002). All of the nine original Solid Waste Management Units listed in the Texas RCRA permit (HW-50296) have been closed. However, there are still active remediation sites at Fort Bliss. The Biggs Field Blimp Base site and the Bulk Fuel Farm in the southern part of Biggs AAF are the only Installation Restoration Program (IRP) sites in the ROI. None of these sites are known to contaminate groundwater (Dodge 2003). Guidance for obtaining additional information about hazardous waste generated on Fort Bliss can be found at www.tdh.state.tx.us/beh/hazcom/CRTK.doc.

There are no hazardous waste sites or leaking petroleum storage tank (LPST) sites at the EPIA. Hazardous wastes generated include spent deicer and low volumes of spent oils, solvents, cleaners, and pesticides.

There are essentially no hazardous wastes generated by the FHWRP. Hazardous chemicals used during the treatment process are either incorporated into the effluent or incorporated in the sludge from the anaerobic digesters.

USEPA environmental databases (Toxic Release Information System, CERCLA Information System [CERCLIS], RCRA Information System [RCRIS], and Enviromapper) were searched to establish the existence of hazardous wastes sites or hazardous materials handlers other than the entities identified above. A multiple database query was performed on USEPA's Toxic Release Information System, CERCLIS, and RCRIS databases focusing on the following zip codes 79906, 79916, 79925, 79937, and 79938 in the immediate vicinity of the ROI. There were no CERCLIS sites in those areas. Additional queries using Enviromapper focused on zip codes 79925, 79906, and 79937.

There are a number of hazardous waste handlers (87 reporting to USEPA) in the region south of Forth Bliss Main Cantonment, of which only five have had toxic releases: W.R. Grace; Hasbro, Inc.; Epson El Paso, Inc.; Chevron El Paso Asphalt Refinery; and Plainfield Stamping of Texas. There also are a number of hazardous waste handlers (72 reporting to USEPA) in the region south of Forth Bliss Main Cantonment Area, of which only 4 have had toxic releases: Allegiance Healthcare Corp., Diesel Recon Company, Rockwell International Corp., and Rockwell Semiconductor Systems, Inc. In the region south of the EPIA, there are 26 listed handlers of hazardous waste and no spills reported. There are

10 hazardous waste handlers reporting to USEPA in the immediate vicinity of the FHWRP. Of these, three have reported toxic releases: Bruce Foods Corp., Dal Tile Company (an air release), and International Wire Railroad.

A search of the TCEQ LPST environmental database revealed 515 LPSTs registered in the county; 27 of those were on Fort Bliss, 465 were within El Paso city limits, and the remaining were in the City of Fabens. The Corrective Action database search reported 33 facilities with SWR/ID Nos. in El Paso County. The most notable of those listed are EPIA (closed site) and Fort Bliss (active site).

3.4.3 Safety

Potential ground safety hazards in the South Training Areas of Fort Bliss include military maneuver training. However, these activities are not conducted at or in the immediate vicinity of the alternative desalination plant sites or the FHWRP. Military training activities are conducted in the vicinity of the proposed deep-well injection site. However, the area for the candidate desalination facilities and infrastructure would not be exposed to close ordnance explosions or detonations as a result of training or testing. Army activities on Fort Bliss and at Biggs AAF are conducted by trained and qualified personnel, in accordance with applicable military technical directives and safety procedures.

There are no identified activities or conditions in the immediate vicinity of EPIA that create ground safety concerns. Day-to-day activities associated with operation of the EPIA are conducted in accordance with standards prescribed by the FAA, and applicable federal Occupational Safety and Health directives.

Flying operations at EPIA predominately involve commercial aviation, and operations at Biggs AAF involve military aircraft. FAA and DOD regulations restrict activities in the vicinity of airports that pose a treat to aviation, including structures that penetrate approach and departure paths and water bodies and landfills that attract birds. Waivers may be obtained for nonconforming facilities. Section 3.7 Land Use and Aesthetics presents additional information on airfield safety zones associated with EPIA and Biggs AAF.

3.5 AIR QUALITY

This section describes the current air quality conditions in the area around Fort Bliss, Texas, and compares it to the relevant federal and state air quality standards. Air quality in a given location can be described by the concentration of individual pollutants in the atmosphere and is generally expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions. Meteorological conditions have a significant impact on the pollutant concentrations because they control the dispersion or mixing of pollutants in the atmosphere through the influences of wind speed, wind direction, atmospheric stability, and other meteorological variables. For example, summer thunderstorms can produce dust storms that carry large quantities of particulate matter high into the atmosphere.

The main pollutants of concern considered in this air quality analysis include volatile organic compounds (VOCs), ozone (O_3), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and particulate matter less than 10 microns in diameter (PM_{10}). Although VOCs or NO_x have no established ambient standards, they are important precursors to O_3 formation, and therefore their emissions are often regulated.

The ROI for inert pollutants (all pollutants other than ozone and its precursors) is generally limited to a few miles downwind of a source. For PM_{10} emissions from construction and operational activities at Fort

Bliss, the ROI is limited to the area immediately surrounding the construction sites. For large sources of ozone precursors, the ROI for ozone can extend much farther downwind than for inert pollutants. In the presence of solar radiation, the maximum effect of VOCs and NO_x emissions on ozone levels usually occurs several hours after they are emitted and many miles from the source. For this project, the ROI for air quality is the El Paso area in the vicinity of Fort Bliss.

3.5.1 Applicable Regulations and Standards

Comparing the concentration of a pollutant in the atmosphere to relevant federal and state ambient air quality standards determines the significance of that pollutant in a region or geographical area.

3.5.1.1 Federal Air Quality Standards

Under the authority of the Clean Air Act (CAA), USEPA has established nationwide air quality standards to protect public health and welfare, with an adequate margin of safety. These federal standards, known as the National Ambient Air Quality Standards (NAAQS), were developed for six "criteria" pollutants: O_3, NO_2, CO, $PM_{10,}$ SO_2, and lead (Pb). The standards are defined in terms of concentration (e.g., ppm) determined over various periods of time (averaging periods). Short-term standards (1-hour, 8-hour, or 24-hour periods) were established for pollutants with acute health effects, while long-term standards (annual periods) were established for pollutants with chronic health effects. These standards are shown in **Table 3-4**.

In 1997, the USEPA promulgated two new standards: a new 8-hour O_3 standard (which could eventually replace the existing 1-hour O_3 standard) and a new standard for particulate matter less than 2.5 microns (µm) in diameter ($PM_{2.5}$), which are fine particulates that have not been previously regulated. In addition, the USEPA made a minor revision to the form of the existing PM_{10} standard. The two new standards are scheduled for implementation over the next few years.

In April 2004, El Paso County was designated as in attainment for the new 8-hour O_3 standard, and the current 1-hour O_3 standard will be revoked in July 2005. Based on recent monitoring for $PM_{2.5}$ in El Paso County by TCEQ, it appears that El Paso County is complying with the $PM_{2.5}$ standard. However, EPA is not scheduled to designate $PM_{2.5}$ attainment status for areas until December 2004.

3.5.1.2 State Air Quality Standards

Under the CAA, state and local agencies may establish air quality standards and regulations of their own, provided these are at least as stringent as the federal requirements. TCEQ has adopted the NAAQS as their state standards. Table 3-4 shows the national and state ambient air quality standards that apply to Fort Bliss (TCEQ 2003).

3.5.1.3 Attainment Areas

USEPA has classified all areas of the U.S. as meeting the NAAQS (in attainment) or not meeting the NAAQS (in nonattainment) for each individual criteria pollutant. Under the CAA, state and local agencies may establish air quality standards and regulations of their own, provided they are at least as stringent as federal requirements. The CAA Amendments of 1990 established a framework to achieve attainment and maintenance of the health-protective NAAQS. Title I sets provisions for the attainment and maintenance of the NAAQS.

Table 3-4. Ambient Air Quality Standards

Air Pollutant	Averaging Time	Federal NAAQS		Texas AAQS	
		Primary	Secondary	Primary	Secondary
Carbon Monoxide (CO)	8-hour 1-hour	9 ppm 35 ppm	— —	9 ppm 35 ppm	— —
Nitrogen Dioxide (NO_2)	AAM 24-hour	0.053 ppm	0.053 ppm —	0.053 ppm —	0.053 ppm —
Sulfur Dioxide (SO_2)	AAM 24-hour 3-hour	0.03 ppm 0.14 ppm —	— — 0.5 ppm	0.03 ppm 0.14 ppm —	— — 0.5 ppm
Particulate Matter (PM_{10})	AAM 24-hour	50 $\mu g/m^3$ 150 $\mu g/m^3$	50 $\mu g/m^3$ 150 $\mu g/m^3$	50 $\mu g/m^3$ 150 $\mu g/m^3$	50 $\mu g/m^3$ 150 $\mu g/m^3$
Particulate Matter ($PM_{2.5}$) [(a)]	AAM 24-hour	15 $\mu g/m^3$ 65 $\mu g/m^3$	15 $\mu g/m^3$ 65 $\mu g/m^3$	— —	— —
Total Suspended Particulates (TSP)	AGM 30-day 7-day 24-hour	— — — —	— — — —	— — — —	— — — —
Ozone (O_3) [(b)]	1-hour 8-hour	0.12 ppm 0.08 ppm	0.12 ppm —	0.12 ppm —	0.12 ppm —
Lead (Pb) and Lead Compounds	Calendar Quarter	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$

$\mu g/m^3$ micrograms per cubic meter
µm micron
AAM Annual Arithmetic Mean
AAQS Ambient Air Quality Standards
AGM Annual Geometric Mean
NAAQS National Ambient Air Quality Standards
ppm parts per million

Notes: [a]The $PM_{2.5}$ standard (particulate matter with less than a 2.5 µm diameter) was promulgated in 1997, and will be implemented over an extended time frame. Areas will not be designated as in attainment or nonattainment of the $PM_{2.5}$ standard until the 2002-2005 time frame.

[b]The 8-hour O_3 standard was promulgated in 1997 and will eventually replace the 1-hour standard. However, the 1-hour O_3 standard will continue to apply to areas not attaining it for an interim period.

Source: TCEQ 2003

3.5.1.4 State Implementation Plans

Individual states are required to establish a State Implementation Plan (SIP), which must be approved by USEPA. A SIP is a document designed to provide a plan for maintaining existing air quality in attainment areas, and programmatically eliminating or reducing the severity and number of NAAQS violations in nonattainment areas. The underlying goal is to bring state air quality conditions into compliance and maintain compliance with the NAAQS.

The principal method of maintaining or improving ambient air quality is by controlling emissions from sources. The SIP establishes regulations to control stationary emission sources; USEPA establishes regulations to control mobile sources, which are installed by vehicle manufacturers. In attainment areas, Prevention of Significant Deterioration (PSD) regulations apply; in nonattainment areas, New Source Review regulations apply.

A number of control regulations can apply to large stationary emission sources, including Best Available Control Technology, New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants, and Maximum Achievable Control Technology. Based on the type of source, the emission levels of criteria pollutants, and the location, one or more of these control requirements may be applicable.

The PSD regulations provide special protection from air quality impacts for certain areas, primarily National Parks and Wilderness Areas, which have been designated as Class I areas. Mandatory PSD Class I areas established under the CAA Amendment of 1977 for the states of Texas and New Mexico are listed under 40 CFR 81.429 and 81.421, respectively. These are areas where visibility has been determined to be an important issue by the USEPA Administrator in consultation with the Secretary of the Interior. The nearest PSD Class I area to Fort Bliss is Guadalupe Mountains National Park, 45 miles to the southeast.

3.5.1.5 Conformity Rule

Under the General Conformity Rule of the CAA, Section 176(c), federal activities must not: (a) cause or contribute to any new violation; (b) increase the frequency or severity of any existing violation; or (c) delay timely attainment of any standard, interim emission reductions, or milestones in conformity to a SIP's purpose of eliminating or reducing the severity and number of NAAQS violations or achieving attainment of the NAAQS.

3.5.2 Regional Climate

Fort Bliss is located in the northern Chihuahuan Desert and has a semi-arid to arid, subtropical desert climate characterized by low rainfall, relatively low humidity, hot summers, moderate winters, wide temperature variations, and an abundance of sunshine throughout the year.

Records of the weather in the area since 1904 indicate an average annual precipitation of 8.8 inches, with extremes ranging from 2.22 inches to 18.29 inches (EPWU 1995). More than one-half of the total average annual precipitation occurs during the months of July, August, and September. During these months, brief but heavy rainstorms frequently cause localized flooding. A small percentage of annual precipitation falls in the form of snow. Periods of extreme dryness lasting up to several months are not unusual.

Fort Bliss has a frost-free season that annually averages 248 days. Temperatures are generally warm, ranging from highs around 55 ºF during the winter months to highs well above 90 °F during the summer. The annual average temperature is 63.3 °F, with a record low of minus 8 °F and a record high of 114 °F. Daytime humidity is generally low, ranging from 10 to 14 percent. Because of the mountainous terrain and the Rio Grand Valley, there are significant diurnal and regional fluctuations in humidity. Typical of desert climates, rapid cooling from nighttime reradiation causes increases in relative humidity. Average daily relative humidity increases to about 40 percent at midnight and to 51 percent by 6:00 a.m.

Wind speeds in the El Paso area are relatively moderate, with an annual average of 9.0 miles per hour (mph). From October through February, average wind speeds range from 8.2 to 9.0 mph and are predominantly from the north. The highest average wind speeds (11.3 mph) occur during the months of March and April, decreasing slightly in May to an average of 10.5 mph. The combination of moderately strong sustained winds and the low average precipitation contribute considerably to the occurrence of dust and sand storms in the area. During the summer months, average wind speeds drop to their lowest levels of the year (less than 8.0 mph). The predominant wind direction during the summer months is from the south-southwest.

A combination of abundant sunshine, high temperatures, low relative humidity, and continuous winds results in an evaporative rate that is more than 10 times the amount of annual precipitation. The annual measured evaporation rate by the National Weather Service in shallow pans (pan evaporation rate) is about 105 inches per year, while the average annual evaporation rate from deeper lakes in the region ranges from approximately 72 to 80 inches.

3.5.3 Regional Air Quality

3.5.3.1 Current Attainment Status

The proposed desalination plant at Fort Bliss is located within the El Paso, Texas metropolitan area. The City of El Paso is in nonattainment for ozone (1-hour), serious classification. The City of El Paso (incorporated limits) is classified as nonattainment for PM_{10}, and downtown City of El Paso is nonattainment for CO. However, as discussed above, the County of El Paso has been designated as in attainment for the new 8-hour O_3 standard, and the 1-hour standard will be revoked next year. Recent Air Quality Data

The TCEQ Office of Air Quality maintains several air quality monitoring sites in El Paso County, most of which are located within or near the El Paso city limits. Four monitoring stations provide representative air quality data for the area near Fort Bliss: C37, C41, C72, and C414 (**Figure 3-10**).

Table 3-5 presents a summary of all available air quality monitoring data at the four stations in 2001. The O_3 standard was exceeded at one of the four monitoring stations during 2001, but no other air quality standard was exceeded.

3.5.4 Existing Air Pollutant Emissions in El Paso County

An emission rate represents the mass of a pollutant released into the atmosphere from a given source or group of sources over a specified period. Emission rates can vary considerably depending on the type of source, time of day, and schedule of operation. Emissions for the El Paso County area are periodically updated by the TCEQ to forecast future emissions, analyze emission control measures, and for input data for regional air quality modeling.

The 2000 emissions inventory for stationary and mobile sources represents the most current emissions data available for El Paso County (Gribbin 2003). A summary of the 2000 emissions inventory for El Paso County is presented in **Table 3-6**. These data show that mobile sources are the largest source of air pollutants within El Paso County, accounting for 97 percent of total CO emissions, 78 percent of total NO_x emissions, and 93 percent of total VOC emissions.

3.6 BIOLOGICAL RESOURCES

Biological resources described in this section include vegetation, wildlife, and sensitive species listed on the federal or state endangered species lists.

Fort Bliss has a high degree of biodiversity. Plant communities on post range from the Chihuahuan Desert plant communities in the Tularosa Basin to Rocky Mountain conifer forests in the Organ Mountains (U.S. Army 1996a, 1997a,b, c). An estimated 1, 200 plant species occur on Fort Bliss (U.S. Army 2001).

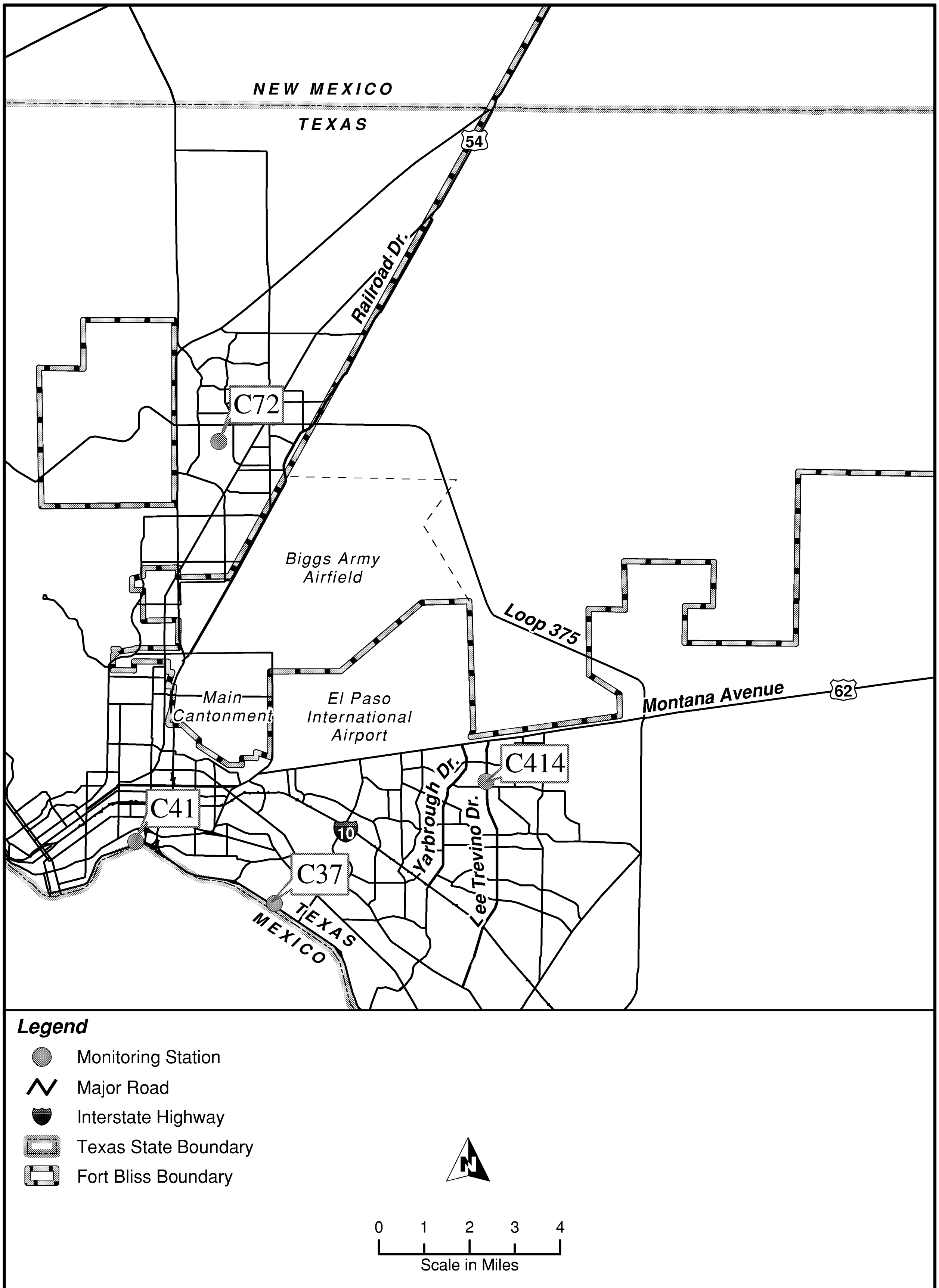


Figure 3-10. Air Quality Monitoring Stations in the Vicinity of Fort Bliss

Table 3-5. Air Quality Monitoring Data for El Paso

Pollutant/Monitoring Station	Averaging Time/ Measurement	Maximum Concentration in 2001	Texas AAQS
CO (ppm)			
Ivanhoe C414	8 hour	3.7	9
Chamizal C41		6.6	
Ascarate Park SE C37		7.5	
Skyline Park C72		2.2	
Ivanhoe C414	1 hour	6.2	35
Chamizal C41		16.0	
Ascarate Park SE C37		16.1	
Skyline Park C72		3.4	
O_3 (ppm)			
Ivanhoe C414	1 hour	0.098	0.12
Chamizal C41		0.133*	
Ascarate Park SE C37		0.109	
Skyline Park C72		0.110	
NO_2 (ppm)			
Chamizal C41	AAM	0.022	0.053
Ascarate Park SE C37		0.017	
Skyline Park C72		0.011	
PM_{10} ($\mu g/m^3$)			
Ivanhoe C414	AAM	25.0	50
Ivanhoe C414	24 hour	76	150
SO_2 (ppm)			
Skyline Park C72	AAM	0.001	0.03
	24 hour	0.006	0.14
	3 hour	0.015	0.5

CO carbon monoxide
O_3 ozone
NO_2 nitrogen oxides
PM_{10} particulate matter 10 microns or less
SO_2 sulfur dioxide
ppm parts per million
$\mu g/m^3$ micrograms per cubic meter
AAM Annual Arithmetic Mean
AAQS Ambient Air Quality Standard

* Exceeded air quality standard in 2001.
Source: USEPA 2003

Table 3-6. Emission Inventory for El Paso County

Source	Year 2000 Emissions (tons/day)			
	CO	NO_x	VOC	SO_2
Stationary Sources	11.4	12.1	2.4	0.7
Mobile Sources				
On-Road Vehicles	299.8	31.9	25.0	1.6
Off-Road Sources	81.9	10.5	6.3	Data Not Available
Subtotal of Mobile Sources	381.7	42.4	31.3	Data Not Available
Total Emissions for El Paso County	**393.1**	**54.5**	**33.7**	**2.3**

CO carbon monoxide
NO_x nitrogen oxides
SO_2 sulfur dioxide
VOC Volatile Organic Compound

Source: Gribbin 2003

Wildlife species diversity is also high. For example, 73 species of reptiles and amphibians (U.S. Army 1997d; Texas Parks and Wildlife Department 2003), and 334 bird species have been recorded on Fort Bliss (Texas Parks and Wildlife 2003; U.S. Army 2000). Studies on Fort Bliss have demonstrated that Fort Bliss' 3,000 miles of dry arroyo riparian areas are used more extensively by wildlife than are adjacent upland areas (Kozma and Mathews 1997; U.S. Army 1997e, 1998a,b).

The ROI for biological resources includes lands in the South Training Areas that would be disturbed by construction of the desalination plant; blend well, feed well, and concentrate pipelines; and alternative concentrate disposal facilities.

3.6.1 Vegetation

3.6.1.1 Vegetation and Cover Types

The vegetation of Fort Bliss has been characterized and mapped using satellite imagery (U.S. Army 1996a, 1997a,b, 2001). The pattern of vegetative cover types in the South Training Areas is presented in **Figure 3-11**. **Table 3-7** lists cover types in each of the Training Areas. Mesquite coppice dunes and sandscrub, dominated by honey mesquite (*Prosopis glandulosa*) coppice dunes, cover an estimated 81 percent of the South Training Areas of Fort Bliss. Dunes are formed when blowing sand becomes trapped among mesquite stems. Four-winged saltbush (*Atriplex canescens*) is also evident in this type, and mesa dropseed (*Sporobolus flexuosus*) is in the sparse understory. In some areas, sand sage (*Artemisia filifolia*) is common with mesquite. Other vegetation such as soaptree yucca (*Yucca elata*) is sparse or absent.

Towards the edge of the dune field, coppice dunes are less well developed, and mesa dropseed, four-winged saltbush, sand sage, and various herbaceous species are locally more common (U.S. Army 1997b). The mesquite dunes give way to a creosotebush (*Larrea tridentata*) plant community on the east side of the South Training Areas on gravelly alluvium in the foothills of the Hueco Mountains. Bush muhly (*Muhlenbergia porteri*) and tarbush (*Flourensia cernua*) are common in some areas in this type. Creosotebush gives way to foothills desert shrublands dominated by lechugilla (*Agave lechuguilla*) and creosotebush on the shallow rocky slopes of the Hueco Mountains. Other shrub species such as ocotillo (*Fouquieria splendens*), mariola (*Parthenium incanum*), pricklypear (*Opuntia* sp.), and skeleton leaf goldeneye (*Viguiera stenoloba*) are also found in this cover type.

Foothill grasslands comprising sideoats grama (*Bouteloua curtipendula*) and black grama (*B. eriopoda*) occur on the alluvial deposits of the Hueco Mountains. This type occurs primarily on rocky and gravelly slopes in the Chihuahuan Desert of the South Training Areas.

Basin grasslands are lowland desert grasslands on depositional soil on flats, swales, and bottomlands. Tobosagrass (*Hilaria mutica*) is common in many areas, often with blue grama (*Bouteloua gracilis*) and alkali sacaton (*Sporobolus airoides*). In other areas, this grassland community is dominated by burrowgrass (*Scleropogon brevifolius*).

Mesa grasslands are dominated by blue and black grama with soaptree yucca (*Yucca elata*). Other less common species are purple threeawn (*Aristida purpurea*) and banana yucca (*Yucca baccata*) (U.S. Army 1996a, 1997b).

The principal plant community in the project area is the mesquite coppice dune type. As indicated above, this is the most common type in the South Training Areas and covers the largest area on Fort Bliss.

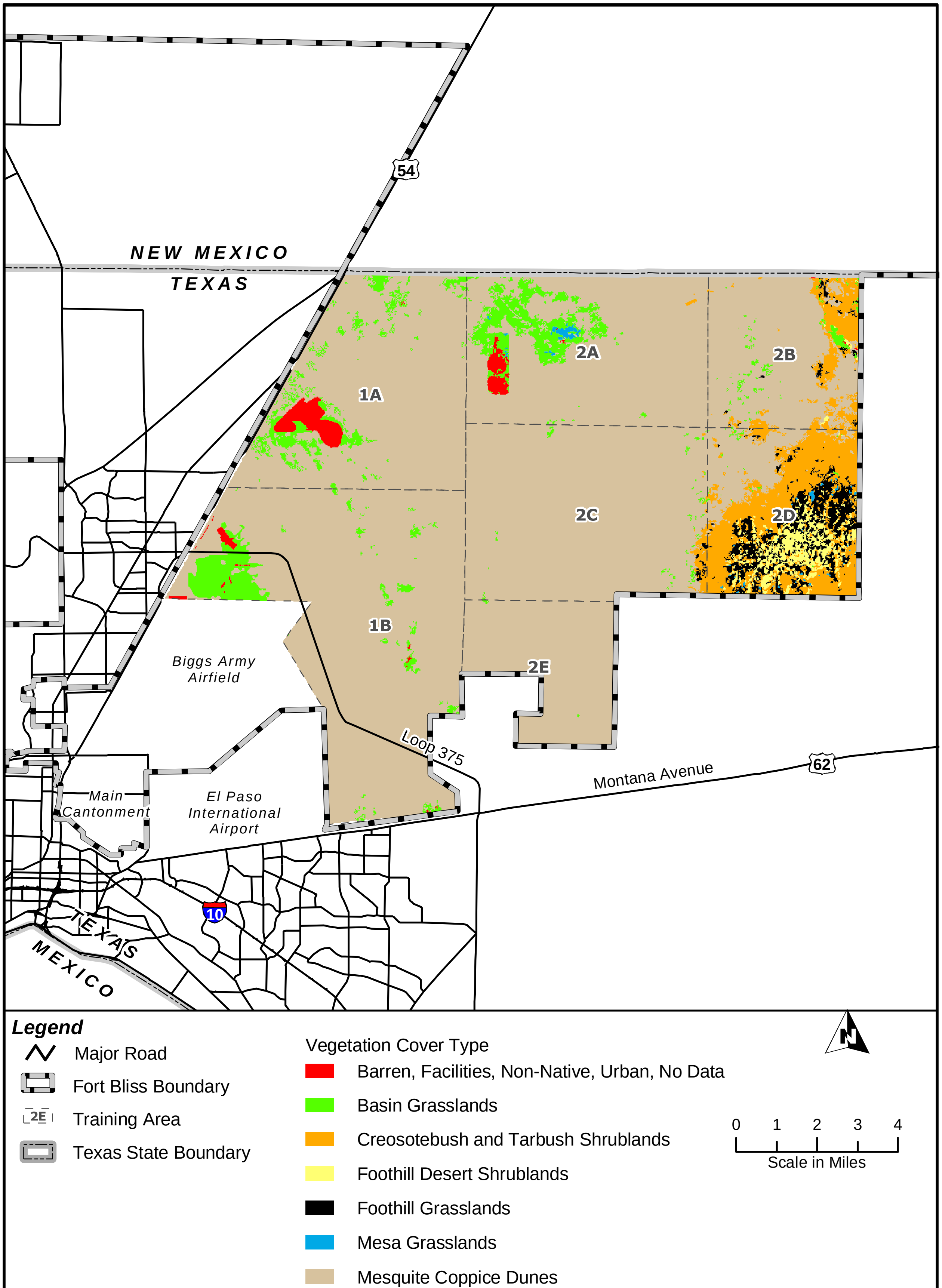


Figure 3-11. Vegetation Cover Types on Fort Bliss South Training Areas

Table 3-7. Cover Types by Training Area on the South Training Areas of Fort Bliss

Cover Type	Training Areas (acres)							Total (acres)	
	1A	1B	2A	2B	2C	2D	2E	Number	Percent
Mesquite coppice dunes and sandscrub	15,384	20,417	14,592	6,652	14,809	1,508	6,721	80,083	81
Creosotebush and tarbush shrublands	0	0	27	1,630	766	4,287	0	6,710	7
Foothill desert shrublands	0	0	0	38	0	1,332	0	1,370	1
Foothill grasslands	0	0		149	61	2,052	0	2,262	2
Basin grasslands	1,256	504	1,798	247	84	26	11	3,926	4
Mesa grasslands	0	0	108	0	2	76	0	186	<1
Barren, facilities, urban, and non-native vegetation	625	101	298	17		0	0	1,041	1
No data		239		792		964	1,384	3,379	3
Total	**17,265**	**21,261**	**16,823**	**9,525**	**15,722**	**10,245**	**8,116**	**98,957**	**100**

< less than
Source: Fort Bliss Directorate of Environment

3.6.1.2 Wetlands and Riparian Areas

A total of 1,228 dry washes with distinct streambeds and sides, covering 1,874 miles, has been mapped in the South Training Areas and McGregor Range, but the great majority occurs on McGregor Range, outside of the project area. There are no Waters of the U.S. as defined in 33 CFR 328.3(a)(3) on Fort Bliss. The only surface water bodies (lakes, sewage lagoons, storm water retention basins, and cattle tanks) that occur near the project area are the 158 acres of oxidation ponds at the FHWRP.

All of the FHWRP oxidation ponds held water on April 17, 2003 (Burt 2003). There was a dense growth of saltcedar in some places (*Tamarix* sp.) as well as large stands of cattail (*Typha* sp.) and bullrush (*Scirpus* sp.). Extensive areas of apparently dead cattail and bullrush were also observed with numerous dead cottonwood (*Populus* sp.) and willow (*Salix* sp.). Smaller evaporation ponds on the east side of the facility contained essentially no vegetation.

3.6.2 Wildlife

3.6.2.1 Amphibians and Reptiles

A total of 8 species of amphibians and 39 species of reptiles has been observed on Fort Bliss; an additional 27 species of amphibians and reptiles have the potential to occur (U.S. Army 1997e,f, 1996b). Amphibian species such as the Great Plains toads (*Bufo cognatus*), green toad (*Bufo debilis*), and Couch's spadefoot (*Scaphiopus couchii*) have been observed in the Tularosa Basin on Fort Bliss and could occur in the project area. The most common lizards captured in the desert shrubland habitat in the Tularosa Basin are the striped whiptail (*Cnemidophorus inornatus*), side-blotched lizard (*Uta stansburiana*), and marbled whiptail (*Cnemidophorus marmoratus*) (U.S. Army 1996c). Species such as the western diamondback rattlesnake (*Crotalus atrox)* and bull snake (*Pituophis catenifer)* are common and widespread throughout Fort Bliss, while species such as the night snake (*Hypsiglena torquata*), plains black headed snake (*Tantilla nigriceps*), and ground snake (*Sonora semiannulata*) are frequently encountered in the desert shrublands in the Tularosa Basin (U.S. Army 1996b).

3.6.2.2 Birds

A total of 334 species of birds has been recorded on Fort Bliss (U.S. Army 2000). Studies of bird life on Fort Bliss have documented breeding bird communities in various habitats, the occurrence of neotropical migrants, and the status of sensitive species (Kozma and Mathews 1997; Kozma 1995; U.S. Army 1996d, 1997g, 1998b).

Breeding Birds – General

In 1996 through 1998, 24 sites were sampled for breeding birds in the Tularosa Basin on McGregor Range in desert shrub habitats dominated by sand sage, mesquite, creosote, and viscid acacia (*Acacia neovernicosa)* (U.S. Army 1996d, 1997g, 1998b). About 8,000 birds and 75 species were recorded each year at these four habitats. The black-throated sparrow (*Amphispiza bilineata)* was by far the most common species, accounting for between 31 and 43 percent of the birds recorded during the three years. The next most common species were the western kingbird (*Tyrannus verticalis*), pyrrhuloxia (*Cardinalis sinuatus)*, Scott's oriole (*Icterus parisorum*), cactus wren (*Campylorhynchus brunneicapillus*), ash-throated flycatcher (*Myiarchus cinerascens*), mourning dove (*Zenaida macroura*), and brown-headed cowbird (*Molothrus ater)*. Species such as the northern mockingbird (*Mimus polyglottos*) and loggerhead shrike (*Lanius ludovicianus*) were less common in mesquite shrublands than in other shrub habitats, while the pyrrhuloxia, black-tailed gnatcatcher (*Polioptila melanura*), brown-headed cowbird, and Gambel's quail (*Callipepla gambelii*) were generally more common in the mesquite shrublands.

An average of 653 nests belonging to 41 species was found in each of the three years studied (U.S. Army 1996d, 1997g, 1998b). In desert shrublands, black-throated sparrow had the largest number of nests. Nests of western kingbirds, cactus wrens, and crissal thrashers (*Toxostoma crissale*) were the next most abundant. The largest number of nests in shrubland habitats was observed in mesquite habitat in 1996 and 1997. This habitat had almost twice as many nests as the next most abundant habitat in 1996 and 1.5 times more in 1997. However, in 1998, mesquite habitat had the third most nests, with the acacia habitat having over twice as many nests, and the creosotebush habitat having over 1.5 times as many.

The existing evaporation ponds near the FHWRP provide valuable habitat for wildlife, particularly for birds. A site survey conducted in April 2003 detected 16 species of birds at the existing evaporation ponds (Burt 2003). Small groups of mallards (*Anas platyrhynchos*), northern shovelers (*Anas clypeata*), and a flock of approximately 40 white-faced ibis (*Plegadis chihi*) were observed in the vegetated ponds along with long-billed curlews (*Numenius americanus*), American coots (*Fulica americana*), red-winged blackbirds (*Agelaius phoeniceus*), and great-tailed grackles (*Quiscalus mexicanus*). Eight black-necked stilts (*Himantopus mexicanus*), eight American avocets (*Recurvirostra americana*), and almost 30 smaller sandpipers, including western (*Calidris mauri*) and least sandpipers (*Calidris minutilla*), were observed feeding in the exposed mudflats in one of the unvegetated ponds. Other species observed here included Wilson's phalaropes (*Phalaropus tricolor*) and lesser yellowlegs (*Tringa flavipes*).

Raptors

Swainson's hawks (*Buteo swainsoni*), turkey vultures (*Cathartes aura*), and red-tailed hawks (*Buteo jamaicensis*) were the most common raptors observed in the mesquite shrublands from 1996 to 1998. (U.S. Army 1996d, 1997g, 1998b). Other species observed infrequently included prairie falcons (*Falco mexicanus*), northern harriers (*Circus cyaneus*), and American kestrels (*Falco sparverius*).

Although quite rare, the bald eagle (*Haliaeetus leucocephalus*) has been recorded in the South Training Areas. Red-tailed hawks and Swainson's hawks are known to nest in desert shrublands on Fort Bliss (U.S. Army 2000).

Neotropical Migrants

Bird species that breed in temperate North America and winter in the tropics are referred to as neotropical migrants. They have become species of concern because of long-term population declines. Forest fragmentation on the breeding grounds and the elimination of optimum wintering habitat in the tropics are likely the two major reasons for these declines (Flather and Sauer 1996; Sheery and Holmes 1996). The loss of important stopover habitat used during migration also may affect the survival of neotropical migrants (Moore et al. 1993).

Five neotropical migrant species of conservation concern occur in mesquite shrublands on Fort Bliss, based on federal species of conservation concern (USFWS 2002) and priority and WatchList species from Partners in Flight and the National Audubon Society (PIF 2002; NAS 2002) (**Table 3-8**).

Table 3-8. Migratory and Other Breeding Bird Species of Concern Found in the Mesquite Shrublands in the Tularosa Basin on Fort Bliss

Species	Number and Percent of All Birds Detected					
	1996		1997		1998	
	Number	Percent	Number	Percent	Number	Percent
Scaled quail	15	0.8	51	2.0	73	3.5
Black-tailed gnatcatcher	38	2.0	97	3.9	84	4.1
Curve-billed thrasher	3	0.2	21	0.8	7	0.3
Crissal thrasher	37	1.9	77	3.1	41	2.0
Scott's oriole	118	6.1	142	5.6	100	4.8

Source: PIF 2002; NAS 2002; U.S. Army 1996d, 1997g, 1998b; USFWS 2002

The average number of scaled quail detected during the three-year study (1996 to 1998) was lowest in the mesquite shrublands (46 detected) and highest in the acacia shrublands (78 detected). Data indicates that this species has declined range-wide, and this seems to be related to habitat degradation, principally from overgrazing. The species does well in areas of moderate grazing (TNC 2000).

The average number of black-tailed gnatcatcher detected from 1996 to 1998 was much higher in the mesquite shrublands (73) than in the other three shrub habitats (range from 10 to 36). This species has decreased range wide (PIF 2002), including in the Chihuahuan Desert (Sauer et al. 2003).

The curve-billed thrasher (*Toxostoma curvirostre*) is the most uncommon of the five neotropical migrant species. It was more abundant in the mesquite and acacia shrublands from 1996 to 1998 (average of 10 and 9 detections, respectively) than the other two shrubland types (average of 2 detections for each). This species has undergone range-wide declines (PIF 2002) due to loss of habitat from urbanization and the introduction of fire resistant grasses on rangeland in Mexico and the U.S. (NAS 2002). It seems to be doing well in the Chihuahuan Desert, where its populations have trended upward from 1966 to 2003. This increase has been more pronounced from 1980 to 2002 (Sauer et al. 2003).

The crissal thrasher was one of the most common breeding birds in the Chihuahuan Desert on Fort Bliss from 1996 to 1998. On the average, it was most abundant in the mesquite shrublands (52 detected) and sand sage (49 detected) and less abundant in the creosotebush (9 detected) and acacia (18 detected) habitats. It has shown a range-wide decline (PIF 2002), but its population in the Chihuahuan Desert has increased from 1966 to 2002 (Sauer et al. 2003).

Scott's oriole was also one of the most common breeding bird species in the Chihuahuan Desert on Fort Bliss, and it reached its greatest average abundance in acacia habitat (140 detected) followed by the sand sage (132 detected), mesquite (120 detected), and creosotebush (114 detected) habitats. Scott's oriole range-wide population is decreasing, but in the Chihuahuan Desert, it is increasing slightly (PIF 2002; Sauer et al. 2003).

3.6.2.3 Mammals

A total of 58 species of mammals is known to occur in the area, and an additional 20 species have the potential to occur. They include 17 species of bats (U.S. Army 2000). Fort Bliss conducted rodent surveys at 24 sampling sites in 12 habitat types on McGregor Range in 1997 and 1998 (Clary et al. 1999). **Table 3-9** lists species trapped along two transects in mesquite coppice dune habitat. The largest number of rodents was captured in the swale and acacia scrub habitat, and the lowest number was in mesquite dunes. Merriam's kangaroo rat (*Dipodomys merriami*) was the most abundant species trapped in the mesquite habitat in both 1997 and 1998, accounting for 75 percent of the small mammals trapped. Ord's kangaroo rat (*Dipodomys ordii*) was the only other small mammal species frequently trapped in mesquite. Other species of mammals that likely occur occasionally in the mesquite habitat are porcupine (*Erethizon dorsatum*), coyote (*Canis latrans*), kit fox (*Vulpes macrotis*), desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), badger (*Taxidea taxus*), and bobcat (*Lynx rufus*).

Table 3-9. Number of Small Mammals Trapped in Mesquite Coppice Dune Habitat on Fort Bliss

Species	1997		1998		Total	
	Spring	Fall	Spring	Fall	Number	Percent
Spotted ground squirrel *Spermophilus spilosoma*	0	1	0	0	1	1.7
Chihuahuan Desert pocket mouse *Chaetodipus eremicus*	0	0	0	3	3	5.0
Rock pocket mouse *Chaetodipus intertmedius*	0	0	0	1	1	1.7
Merriam's kangaroo rat *Dipodomys merriami*	11	13	11	10	45	75.0
Ord's kangaroo rat *Dipodomys ordii*	3	4	0	0	7	12.0
Northern grasshopper mouse *Onychomys leucogaster*	0	1	0	0	1	1.7
Hispid cotton rat *Sigmodon hispidus*	0	1	0	0	1	1.7
White-throated woodrat *Neotoma albigula*	1	0	0	0	1	1.7
Total	**15**	**20**	**11**	**14**	**60**	**100.5**

Source: Clary et al. 1999

3.6.3 Sensitive Species

Sensitive species include federally listed as endangered, threatened, candidate, or proposed, and species listed as endangered or threatened by the state of Texas. **Table 3-10** lists sensitive species known to occur or that have the potential to occur in El Paso County. The table indicates whether each species is likely to occur in the ROI. The bald eagle has been observed in the South Training Areas, and a number of the bird species may use the FHWRP oxidation ponds. One state-threatened species, the Texas horned lizard (*Phrynosoma cornutum)*, is described as widespread and common on Fort Bliss, including in mesquite coppice dune habitat (U.S. Army 2000). Of all the other sensitive species occurring or potentially occurring in El Paso County, none are likely to be present in the South Training Areas, due to lack of suitable habitat.

The Texas horned lizard is listed as threatened by the State of Texas (Texas Parks and Wildlife Department 2004a). This species has been declining for the last 30 years and has disappeared from many parts of its former range in Texas (Texas Parks and Wildlife Department 2004b). Habitat loss and alteration, use of agricultural pesticides, over collecting, and the introduction of the fire ant (*Selenopsis invicta*) may be the major causes of the decline (U.S. Army 1998c). This species is common and widespread on Fort Bliss. It is found in grassland and desert shrubland habitat throughout the post (U.S. Army 1997d). Surveys for this species in various habitat types at the south end of the South Training Areas (mistakenly called McGregor Range in the report) found lizards at 12 of 16 observations in mesquite coppice dune habitat. The sandy soil in the mesquite coppice dune type is conducive to Texas horned lizard burrowing and foraging activity and supports harvester ant (*Pogonomyrmex* sp.) populations, the major prey species for this lizard (U.S. Army 1998c).

The bald eagle has been recorded along the Rio Grande near El Paso. At Rio Bosque Wetlands Park, it is listed as rare during the winter and accidental in the spring (UTEP 2004). It has been recorded in the FHWRP, but is evidently rare at this location (Locke 2004). In general, the species occurs most frequently in areas with open water and tall trees (Buehler 2000). Diet is diverse and includes fish, mammals, and birds (including waterfowl), with carrion becoming important during the winter (Buehler 2000). In 1995, the bald eagle was federally down-listed from endangered to threatened, following a steady increase in population numbers since at least 1980 (Buehler 2000). Bald eagles were estimated at more than 5,000 pairs in the contiguous U.S. in 1997 and 100,000 individuals overall in 1999 (Buehler 2000). Although bald eagle populations have increased, they continue to be threatened by habitat loss, environmental contaminants (i.e., pesticides, heavy metals, and oil spills), powerlines, and human disturbance. Bald eagles are also susceptible to injuries or death from collision with road traffic (Buehler 2000).

Table 3-10. Sensitive Species in El Paso County

Species	Status		Likelihood of occurrence
	Federal	TX	
Plants			
Sneed pincushion cactus (*Coryphantha sneedii* var. *sneedii*)	E	E	Recorded in El Paso County, but not in the ROI. Restricted to limestone hills, which are absent in the South Training Areas.
Reptiles			
Texas horned lizard (*Phrynosoma cornutum*)	-	T	Common and widespread on Fort Bliss, including in mesquite coppice dune habitat.

Table 3-10. Sensitive Species in El Paso County

Species	Status		Likelihood of occurrence
	Federal	TX	
Mountain short-horned lizard (*Phrynosoma douglassii hernandesi*)	-	T	Not recorded in the South Training Areas and not known from mesquite coppice dunes. This lizard is associated with forested areas and semiarid plains at high elevations. The only two known populations in the Trans-Pecos Region are in the Davis and Guadalupe mountains.
Texas lyre snake (*Trimorphodon biscutatus vilkinsoni*)	-	T	Recorded on Castner Range but not in the South Training Areas. Prefers dry, rocky terrain, which does not exist in the ROI.
Birds			
White-faced ibis (*Plegadis chihi*)	-	T	Known to utilize FHWRP oxidation ponds during migration periods.
Piping plover (*Charadrius melodus*)	T	T	Coastal bird, but recorded once in 1987 at sewage pond on Fort Bliss.
Interior least tern (*Sterna antillarum athalassos*)	E	E	Not known to occur on Fort Bliss. Could occur as very rare migrant at sewage lagoon on Fort Bliss.
Bald eagle (*Haliaeetus leucocephalus*)	T	T	Recorded in South Training Areas. Potential for occurrence exists at large evaporation ponds with available prey (aquatic birds), but is very low due to lack of trees.
Zone-tailed hawk (*Buteo albonotatus*)	-	T	Uncommon migrant on Fort Bliss. Unlikely to occur in the South Training Areas. The species is chiefly associated with rocky wooded canyons and tree lined rivers along middle slopes of desert mountains, especially in open deciduous or pine-oak woodland.
Peregrine falcon (*Falco peregrinus*)	-	E/T	Known to utilize FHWRP oxidation ponds during migration periods.
Northern aplomado falcon (*Falco femoralis septentrionalis*)	E	E	As a grassland bird, unlikely to occur in the South Training Areas, which are dominated by shrublands.
Mexican spotted owl (*Strix occidentalis lucida*)	T	T	Not known to occur in the South Training Areas. The species occurs only in higher-elevation wooded communities, which are absent in the South Training Areas.
Southwestern willow flycatcher (*Empidonax traillii extimus*)	E	E	Not known to occur in the South Training Areas. The species is restricted to mesic riparian vegetation, and this habitat does not occur in the South Training Areas.
Yellow-billed cuckoo (*Coccyzus americanus*)	C	-	Known to occur as a migrant at the FHWRP. No other occurrence in the South Training Areas. The species is restricted to riparian gallery forests, and this habitat does not occur in the South Training Areas or on Fort Bliss.
Mammals			
Spotted bat (*Euderma maculatum*)	-	T	Never documented in El Paso County; mostly a forest species, but can occur in low-elevation deserts. However, it is highly dependent on rock-faced cliffs for roosting, and there are no rocky cliffs on the ROI.

Table 3-10. Sensitive Species in El Paso County

Species	Status		Likelihood of occurrence
	Federal	TX	
Black-tailed prairie dog (*Cynomys ludovicianus*)	C	-	Grassland species. Not known to occur in the South Training Areas, despite extensive biological surveys.

E Endangered
T Threatened
C Candidate
FHWRP Fred Hervey Water Reclamation Plant

Sources: U.S. Army 2000; LaDuc and Johnson 2003; Northern Prairie Wildlife Research Center 1998; Texas Parks and Wildlife Department 2004; USFWS 2003

3.7 LAND USE AND AESTHETICS

Land Use

Land use addresses the existing pattern of land use on areas of the Fort Bliss within Texas and areas adjacent to proposed project sites. It also describes areas affected by flight operations at Biggs AAF and EPIA, and identifies state and local land use plans that influence development in the project area. The ROI for land use is the portion of Fort Bliss in Texas, including the Main Post, Biggs AAF, and the South Training Areas; EPIA; and areas proximate to the proposed desalination project site.

Aesthetics

Aesthetics addresses visual resources and odor. Visual resources include natural and human-made physical features that give a particular landscape its character and value. Features contributing to visual perception include landforms, vegetation, size, water, color, texture, adjacent or bounding scenery, and man-made (cultural modifications). Odor involves the absence or presence of undesirable smells in residential areas and other land uses where people could be adversely affected.

The ROI for aesthetics is an area encompassing approximately 2 miles around all areas where proposed desalination project facilities could be built.

3.7.1 Land Use

Land use in the ROI is shown in **Figure 3-12**.

3.7.1.1 Fort Bliss

The portion of Fort Bliss in the ROI includes the Main Cantonment and the South Training Areas.

Main Cantonment

The Main Cantonment is composed of the Main Post (approximately 3,150 acres) and Biggs Army Air Field (6,343 acres). There are several real property out-leases and easements within the Main Cantonment, primarily for utility lines and fixtures.

Main Post. The Main Post is bounded on the north and northeast by Biggs AAF; on the east by EPIA; and on the south and west by mixed residential, commercial, and industrial uses in the City of El Paso. Except for the south boundary, the edges of the Main Post are defined by Patriot Freeway to the west, Fred Wilson Road to the north, and Airport Road to the east. The Main Post includes a broad range of land uses. Overall, uses directly supporting mission activities occur in the east half (east of Jeb Stuart Road), with generally smaller-scaled community support, residential, and administrative functions on the west half of the Main Post.

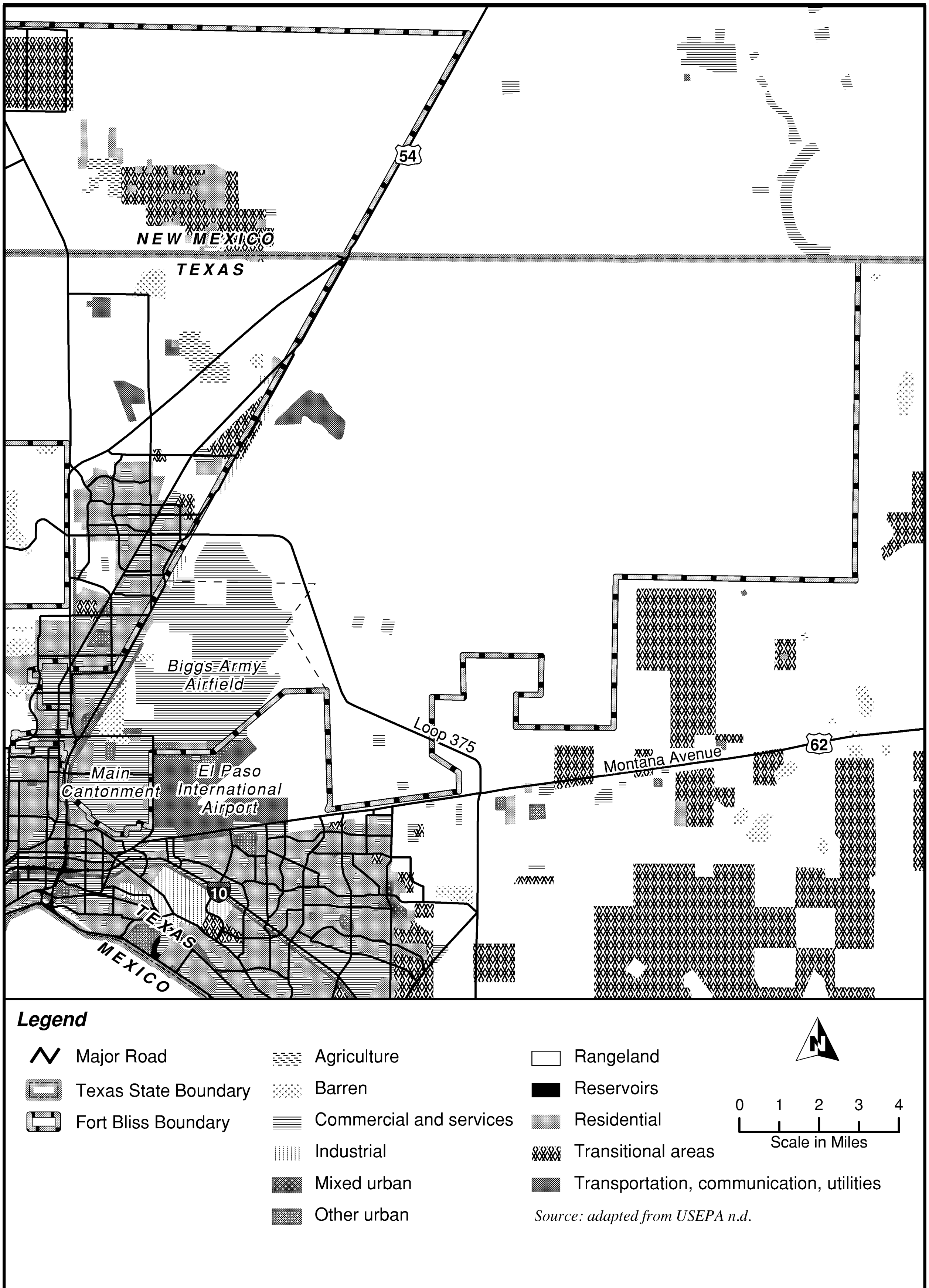


Figure 3-12. Land Use in the ROI

Biggs AAF. Biggs AAF is located north and east of the Main Post. Biggs AAF is dominated by the airfield oriented around one 13,572-foot long runway, associated taxiways, and aircraft parking aprons that can support large C-5A and B-747 aircraft. The primary concentration of facilities and activities on Biggs AAF is between the runway and EPIA to the south.

To the east of the airfield is a federal prison compound. South of Sergeant Major Boulevard are open-space areas, the Aero Vista family housing area, and the Ben Milam Elementary School.

To the north and west of the runway is the Ammunition Supply Point. For the most part, open space lies to the south of the Ammunition Supply Point, between Fred Wilson Road and the railroad corridor. This area also has a small industrial area linked to the airfield by a taxiway. The southwest corner of Biggs AAF has a large storm water pond adjacent to city-owned property. Fort Bliss has retained a perpetual easement from the city of El Paso for a strip of land along the southeast boundary line between Biggs AAF and EPIA. An unpaved roadway in this easement provides access to the north end of the airfield and training areas to the north.

South Training Areas

The South Training Areas includes 104,042 acres divided into seven Training Areas (see Figure 2-6). They are primarily used for on- and off-road wheeled and tracked vehicle training and travel and dismounted (ground troop) training operations. Distributed throughout are several areas with environmental restrictions. Several archaeological sites and areas are protected and designated as off-limits for vehicle use. The public has limited access to some areas for recreation and hunting, to the extent that it does not conflict with military uses.

3.7.1.2 Adjacent Land Uses

Alternative Desalination Plant Sites

The area of the alternative desalination plant sites is bordered by Biggs AAF on the north-northwest, Fort Bliss South Training Areas to the north and east, and EPIA to the west. Loop 375, which was transferred as a perpetual easement to the City of El Paso, is approximately half a mile to the east. Montana Avenue is approximately 2,000 feet south of the nearest alternative site. The nearest commercial land uses are on the north side of Montana Avenue, and Residential uses south of Montana Avenue are about a half mile away. Sparsely developed residential uses to the north-northwest are about 5.5 miles away.

The area between Loop 375 and the western boundary of the South Training Areas (at U.S. Highway 54 [US 54]) is moderately used for military training and is accessible to the public for hiking, jogging, dog walking, and hunting.

EPIA is located to the east of the Main Post and south of Biggs AAF, west-southwest of the proposed desalination plant sites. The airport provides commercial passenger service, general aviation, air cargo, overnight air package, and freight service. There is an industrial park adjacent to the airport along Montana Avenue and Airport Road. Hotels, restaurants, and packaging and freight businesses support associated activities. The airport plans to expand the industrial park and air-related industry in existing areas east of Airport Road and along Montana Avenue.

In the long term, additional industrial park and airfreight services may be developed on the east side of the airfield with a new inner loop highway linking Montana Avenue to Airport Road through the airport, and a possible connection to Loop 375.

Zoning in the area largely corresponds to current land use. The *Plan for El Paso* (City of El Paso 1999) indicates that land uses will tend to follow the current pattern, with new industrial and commercial development focused on the major arterials.

Deep-Well Injection Site

The deep-well injection site is fully enclosed by Fort Bliss South Training Areas. The nearest residential area is approximately 3.8 miles to the southeast. Hueco Tanks State Park is approximately 8 miles southeast of the deep-well injection site.

Evaporation Ponds Site

The FHWRP oxidation ponds are located within the Fort Bliss perimeter east of Railroad Road (US 54) and north of Loop 375. On the west side of US 54, the land is mostly undeveloped with pockets of residential development. The closest residential use is about 1 mile west of the existing oxidation ponds, an area consisting primarily of mobile homes. The El Paso urban fringe is about 2 miles southwest of the FHWRP, and an established unincorporated subdivision is about 3.5 miles northwest of the existing ponds.

Military training activities in this area are not extensive because of the proximity of the FHWRP and off-base development. Hunting is not allowed within 328 feet of the FHWRP (U.S. Army 2000).

3.7.1.3 Airfield Compatible Use

The Army's Installation Compatible Use Zone program recommends land use compatibility guidelines for areas exposed to increased safety risks and noise in the vicinity of military airfields and to maintain a safe environment for aviation. Three areas are delineated at both ends of the runways where the probability of aircraft accidents is highest: the Clear Zone, Accident Potential Zone I, and Accident Potential Zone II (**Figure 3-13**). None of the alternative desalination sites lie within the Clear Zones or Accident Potential Zones for Biggs AAF.

The FAA defines safety clear zones for civil and commercial airports. The clear zones for runways on EPIA are within the airport's boundary (see Figure 3-13). None of the alternative desalination project sites lie within these clear zones.

Under the Installation Compatible Use Zone and FAA programs, recommendations of land use compatibility based on noise exposure have also been developed. Both sets of guidelines are based on the Federal Interagency Committee on Urban Noise Report of 1980. **Table 3-11** identifies land use compatibility relative to Day-Night Average Sound Level (L_{dn}).

3.7.1.4 State and Local Land Use Management and Planning

The ROI contains lands owned, managed, or administered by the State of Texas, El Paso County, and the City of El Paso. Each is briefly described below.

State Government

The Texas Department of Transportation manages the Loop 375 right-of-way through the ROI.

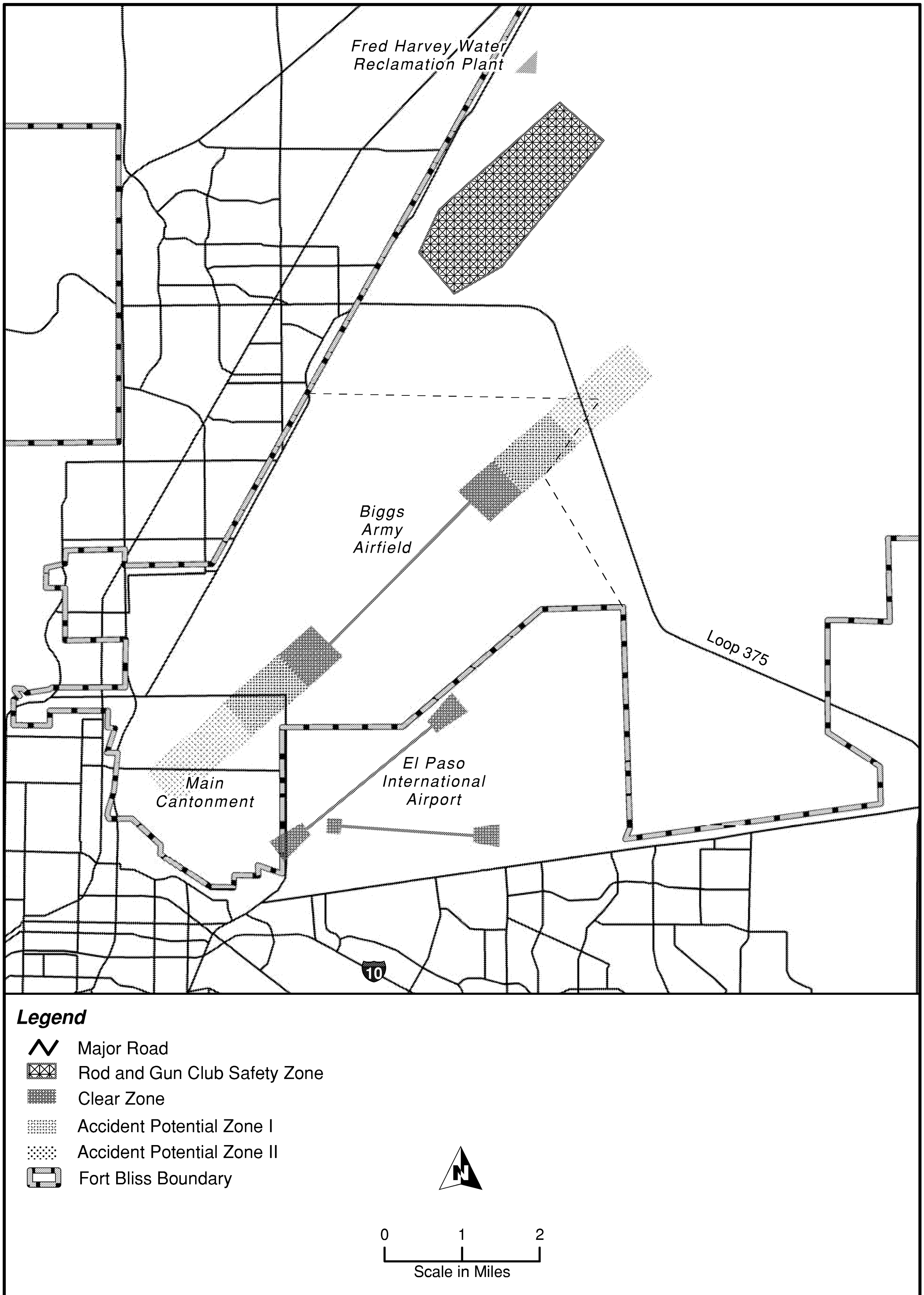


Figure 3-13. Safety Zones in the Project Area

Table 3-11. Land Use Compatibility Guidelines – Federal Aviation Regulations Part 150

Land Use	DNL in dB					
	Below 65	65-70	70-75	75-80	80-85	Over 85
Residential						
Residential, other than mobile homes and transient lodgings	Y	N[1]	N[1]	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N[1]	N[1]	N[1]	N	N
Public Use						
Schools, hospitals, nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y[2]	Y[3]	Y[4]	N[4]
Parking	Y	Y	Y[2]	Y[3]	Y[4]	N
Commercial Use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail—building materials, hardware, and farm equipment	Y	Y	Y[2]	Y[3]	Y[4]	N
Retail trade, general	Y	Y	25	30	N	N
Utilities	Y	Y	Y[2]	Y[3]	Y[4]	N
Communication	Y	Y	25	30	N	N
Manufacturing and Production						
Manufacturing, general	Y	Y	Y[2]	Y[3]	Y[4]	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y[6]	Y[7]	Y[8]	Y[8]	Y[8]
Livestock farming and breeding	Y	Y[6]	Y[7]	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y	Y[5]	N[5]	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables, and water recreation	Y	Y	25	30	N	N

dB decibel
N (No) Land use and related structures are not compatible and should be prohibited.
NLR Noise Level Reduction (outdoor and indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
Y (Yes) Land use and related structures compatible without restrictions.
25,30,35 Land use and related structures generally compatible; measures to achieve a NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

Notes: 1 Where the community determines that residential or school uses must be allowed, measures to achieve outdoor-to-indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.
2 Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
3 Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
4 Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
5 Land use compatible provided special sound reinforcement systems are installed.
6 Residential buildings require a NLR of 25 dB.
7 Residential buildings require a NLR of 30 dB.
8 Residential buildings not permitted.

Source: FICUN 1980

County Government

El Paso County borders the south and east boundaries of the South Training Areas. El Paso County has no comprehensive land use plan, largely because it has no legislative authority to control development except to ensure that lot sizes can accommodate required on-site wastewater storage and treatment for the structure(s) proposed. The Model Subdivision Rules passed by the Texas legislature in 1989 and the "Colonias Bill" passed in 1995 have stopped development of new subdivisions that have no basic infrastructure, such as water and sewer services. Nevertheless, Colonias have developed in unincorporated areas of the county. Colonia lots are subdivided and sold without water and sewer infrastructure. A number of Colonias exist east and south of the Fort Bliss boundary, including the area south of the proposed deep-well injection site.

El Paso County has adopted a plan for Colonias that describes an aggressive program for providing public facilities as well as decent, safe, and sanitary housing to existing Colonias. The plan includes a policy to "seek legislative relief to regulate land use and to address the re-development of both housing and commercial areas and to prohibit the habitation of identified flood zones" (El Paso County 2000).

Municipal Government

The City of El Paso shares a boundary with the Fort Bliss Main Cantonment and the western edge of the South Training Areas. The city has jurisdiction for planning and zoning of incorporated areas within five miles of the city. A comprehensive plan, *Plan for El Paso*, was developed in 1999 (City of El Paso 1999). The current zoning ordinance implements this plan.

3.7.2 Aesthetics

3.7.2.1 Fort Bliss South Training Areas

Fort Bliss is located in arid high plains of western Texas and southern New Mexico. The natural context of the Fort Bliss South Training Areas is semi-arid to arid Chihuahuan Desert, characterized by vistas framed by distant mountain ranges or escarpments, dominated by the overlying blue sky. Variations in elevation and precipitation result in a range of vegetative regimes with indistinct boundaries. These create a patchwork of varying textures and patterns in the middle and distant landscape, caused by bunched or continuous grassy vegetation and areas of scattered shrubby vegetation. Broad valley floors and alluvial slopes are bisected by steep-sided, relatively shallow, ephemeral streams that provide visually interesting forms in the foreground and that are less noticeable at a distance. Mixed hues of reddish brown, and gray-colored soils, rocks, and woody vegetation are the dominant colors of the ground plane. In some areas, clumped or grassy vegetation introduce a range of pale sage and dark gray hues. Low angle light at sunset and sunrise augments the color of the sky and landscape and increases the visibility of sculpted forms. However, in general, the natural landscape does not have outstanding features of visual interest.

The South Training Areas are composed of mesquite dunes. Portions of the South Training Areas have also been disturbed by off-road tracked vehicle operations, leaving denuded patches that are highly noticeable in the foreground, but do not alter the overall middle and distant visual character. Northeast of the South Training Areas, the Hueco Mountains foothills rise from the desert floor providing moderate visual interest in the distance. The lower slopes have relatively little, mostly low-growing vegetation.

The cultural landscape is defined by both the natural setting and by human modifications. Throughout the area, constructed features are evidence of current and past uses and events. These include paved and unpaved roadways, fences, wooden corrals, isolated homesteads, power lines, watering tanks, windmills, pipelines, antennae, and satellite dishes. Most of these are noticeable in the foreground, but are either not perceptible, or only defined by subtle lines or forms in the middle and distant landscape. The new Loop 375 highway corridor is defined by chain link fences. The FHWRP is an existing large-scale modification in the desert landscape within the project area.

3.7.2.2 Adjacent Areas

Urban areas adjacent to the South Training Areas are a mixture of residential, commercial, and industrial uses. To the south and west, one- and two-story homes on small lots are interspersed with neighborhood commercial shops along arterial roadways. Many of the homes, built of frame-and-stucco construction, have simple forms with flat roofs. Incremental growth is reflected in additions to the main structure and outbuildings on many lots. Red-tiled roofs are common on larger buildings in the middle and distant viewing areas, providing interest and individuality to the cityscape.

US 54 forms a major visual barrier between the South Training Areas and adjacent neighborhoods to the west, primarily because of its width and level of traffic. The railroad tracks along the western edge of the South Training Areas are elevated above the surrounding terrain in some locations, also forming a visual barrier. Commercial strip development between US 54 and the South Training Areas is dominated by signage and parking lots. The buildings are usually fairly new with cohesive building types.

Montana Avenue forms a visual barrier between the South Training Areas and residential areas south of Fort Bliss. Commercial strip development dominates the corridor across from the Main Cantonment of Fort Bliss and EPIA. Nearer the project area, in the vicinity of Yarbrough and Lee Trevino Drives, much of the land directly abutting the south side of Montana Avenue is vacant. South of there are residential areas with a currently unobstructed view of the South Training Areas. It is expected that the vacant land will eventually be developed with commercial uses, which will block northerly views from the residential areas located to the south.

The City of El Paso has several designated historic districts that provide pockets of strong visual and cultural identity for the community. None of these districts are near the project area. The closest is the Austin Terrace historic district, also known as Government Hills, less than half a mile south of the Old Post historic area on the Main Post.

The *Plan for El Paso* (City of El Paso 1999) offers general goals for improving the appearance of the city through creation of scenic corridors, sign control, landscaping, and litter control. There are design guidelines for industrial development that include site location and configuration recommendations. Zoning ordinances address signage and landscaping standards, and scenic corridors with restrictive signage standards have been established to lessen visual intrusion from signs and billboards. Airport Drive and Fred Wilson Road from Robert E. Lee to Railroad Drive, located to the north and east of the Main Post, is the closest scenic corridor to the project area.

3.7.2.3 Visual Sensitivity

Visual sensitivity of the existing landscape is dependent on its visual character, amount of public use, public visibility, presence or absence of adjacent developments, and ability of the setting to absorb the proposed structure(s). Absorption refers to how well the proposed facility would fit within the existing setting. The visual sensitivity ratings consist of the following:

- **High Visual Sensitivity**. Areas with unique or valued visual attributes, minimal landscape disturbance, high visibility, and high public activity, because they have a limited ability to absorb changes that are not visible.

- **Moderate Visual Sensitivity**. Areas with typical visual attributes, surrounding development, lower visibility, limited public visibility, and disturbed landscape, because they have some ability to absorb changes without appearing to have changed.
- **Low Visual Sensitivity**. Areas with pervasive or degraded visual attributes, limited public use and viewing, or areas with development similar in characteristics to the proposed facilities, because they can absorb changes without appearing noticeably different.

The alternative desalination plant sites and evaporation pond site are areas of low visual sensitivity. Those areas have been disturbed either by military training exercises or adjacent construction. The area where the alternative sites for the proposed desalination plant are located is adjacent to EPIA and just north of a limited access roadway facility abutted by commercial development. The area under consideration for the evaporation ponds is adjacent to existing ponds and the EPWU FHWRP. The deep-well injection site is remote and used for training and off-road vehicle recreation. The landscape in this area is not distinctive but it is relatively natural and undisturbed, so it is considered moderately visual sensitive.

3.7.2.4 Odor

Odors in the vicinity of the alternative desalination sites are dominated by exhaust and fumes from vehicles and aircraft. Generally, odors from petroleum sources dissipate and only have very localized effect. In the vicinity of the FHWRP, sources of odor can include the oxidation ponds and a nearby food canning plant.

3.8 TRANSPORTATION

Transportation and circulation systems include roadways, railroads, and airports. The ROI for the transportation and circulation systems is displayed in **Figure 3-14**. The deep-well injection facility would be accessed by unpaved roads that are not displayed in the roadway system.

3.8.1 Roadways

The major interstate that provides access to El Paso and Fort Bliss is Interstate 10 (I-10) as shown on Figure 3-14. I-10 is a major east-west limited-access highway that runs through downtown El Paso and passes just south of the Main Cantonment. It is the most heavily traveled roadway in El Paso. US 54 (Patriot Freeway), a major non-Interstate freeway, provides northern access to Alamogordo, New Mexico.

The four major transportation corridors – Northeast, Northwest, Southeast, and Central City – all come together within the vicinity of the Main Cantonment and EPIA. Loop 375 connects the northeast and eastern portions of the city. Loop 375 crosses the Fort Bliss installation between Montana Avenue and US 54. Overpasses have been constructed to allow military vehicles and equipment to pass under the roadway, thus avoiding interference with military operations. West of US 54, Loop 375 becomes Woodrow Bean Trans Mountain Drive, which connects to I-10 northwest of El Paso. Loop 375 is the nearest Hazardous Cargo route near the alternative desalination plant sites.

The evaluation of roadway conditions is based on capacity estimates (Transportation Research Board 1994). The capacity of a roadway depends on the number of lanes, lateral obstructions, percentage of trucks in the traffic stream, intersection control, and other physical factors specific to the type of roadway.

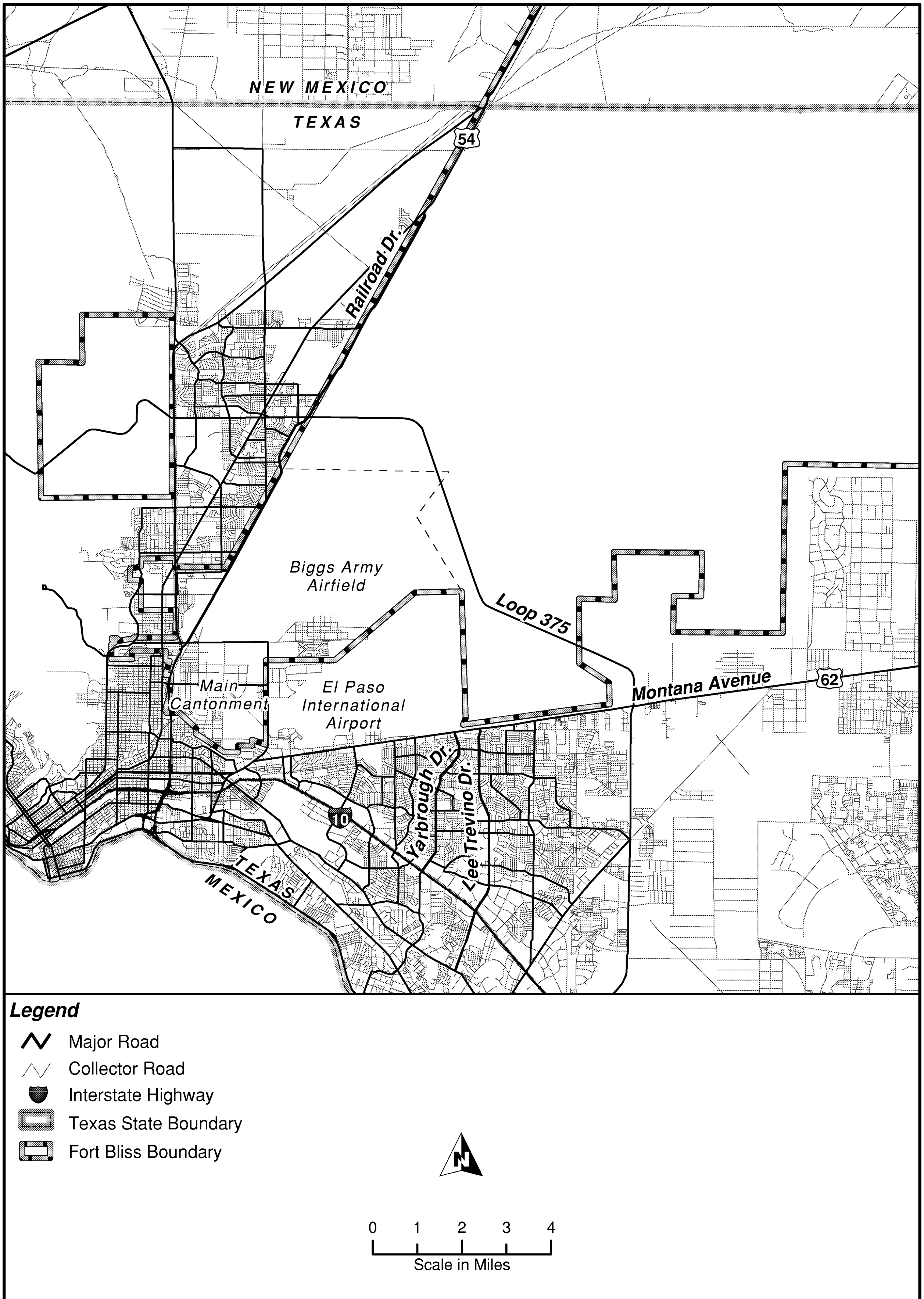


Figure 3-14. Transportation and Circulation in the ROI

Traffic volume is typically reported as Annual Average Daily Traffic (AADT), which is the total number of vehicles per day averaged over an entire year. The AADT may be measured directly with continuous count equipment, but locations with such equipment are limited. The AADT may also be estimated by taking short traffic counts, called Average Daily Traffic, usually for two consecutive days, and adjusting the counts with factors derived from the AADTs to account for daily and seasonal variations.

The AADT factors for estimating the percent of daily traffic that occurs during the peak hour are called K-factors. Further, capacity analysis for highways with four or more lanes is conducted for each direction during the peak hour. Therefore, continuous count locations are used to estimate peak hour directional distributions factors, called D-factors. Applying K- and D-factors to an AADT value establishes the peak hour volume that is used in determining the capacity of a particular roadway.

A comparison of a roadway's AADT to its capacity is expressed in terms of level of service (LOS). The LOS scale ranges from A to F, where A is the best (free-flow conditions) and F is the worst (stop-and-go conditions). LOS A, B, and C are considered good operating conditions while LOS D is considered below average, and LOS E and F are considered unacceptable. Volume (AADT)-to-capacity ratios as they relate to LOS values are shown in **Table 3-12**.

Table 3-12. Roadway Levels of Service

LOS	Description	Criteria (volume/capacity)		
		Freeways	Signalized Intersections	Two-Lane Highways
A	Free flow with users unaffected by presence of other users of roadway	0.32	0.50	0.15
B	Stable flow, but presence of the users in traffic stream becomes noticeable	0.50	0.65	0.27
C	Stable flow, but operation of single users becomes affected by interactions with others in traffic stream	0.75	0.85	0.43
D	High density, but stable flow; speed and freedom of movement are severely restricted; poor level of comfort and convenience	0.90	0.95	0.64
E	Unstable flow; operating conditions at capacity with reduced speeds, maneuvering difficulty, and extremely poor levels of comfort and convenience	1.00	1.00	1.00
F	Forced breakdown flow with traffic demand exceeding capacity; unstable stop-and-go traffic	>1.00	>1.00	>1.00

> greater than
LOS level of service
Source: Transportation Research Board 1994

Table 3-13 presents the results of capacity analysis on the nearest roadway segments to project sites. The traffic numbers represent the AADTs from which the peak vehicles per hour terms were derived. The comparison of the vehicle per hour terms to the capacity figures resulted in the volume-to-capacity numbers, which in turn were used to select the applicable LOS from Table 3-14. The capacity terms were derived by using the following assumptions:

- 2,300 vehicles per hour per lane for freeways and interstates; and
- 900 vehicle per hour per lane for signalized arterials, with the exception of Montana Avenue, for which 1,100 vehicles per hour per lane is assumed.

Table 3-13. Capacity Analysis of Area Roadways, 2001

Roadway	Capacity (vehicles per hour)	Traffic in 2002 (vehicles per day)	Volume (vehicles per hour)	Volume-to-Capacity Ratio	Level of Service
US 54 (Patriot Freeway) North of Cassidy Road	4,140	85,000	4,608	1.11	F
Loop 375 at Montana Avenue	6,210	13,400	713	0.11	A
Loop 375 at Dyer Street	8,280	11,700	635	0.08	A
Loop 375 at US 54	4,140	15,400	830	0.20	A
Montana Avenue at Hawkins Road	2,970	33,000	2,067	0.70	C
Montana Avenue East of Yarbrough Road	1,980	37,000	2,316	1.17	F
Montana Avenue West of Lee Trevino	1,980	33,430	2,093	1.06	F

Note: Levels of Service A - C are generally acceptable; Levels of Service D and F are generally unacceptable. Projection assumes improvements will be made as planned.
Source: El Paso Traffic and Transportation Department 1996; TxDOT 2001

In addition, K- and D-factors were developed using the 1994 Highway Performance Monitoring System data collected by the TxDOT and the City of El Paso, for roadways in the El Paso area. Capacity flow rates were reduced by 10 percent to account for trucks in the traffic stream and other physical factors affecting capacity.

The Metropolitan Planning Organization (MPO) has identified several new highway projects in its 2001 MPO Transportation Improvement Plan that would improve roadways in the ROI. This Plan includes a proposal for an Inner Loop freeway that would connect Loop 375 and Lee Trevino in east El Paso, with Fred Wilson Road at the Airport/Fred Wilson intersection and proceed west of the Patriot Freeway (US 54). The loop would be located east and north of EPIA, passing between the airport and Biggs AAF. “One of the purposes of the Inner Loop is to provide a direct route for trucks in the area to reach US 54 and Loop 375, relieving congestion on Airport Rd., Airway Blvd., Montana Ave., Paisano Dr., and other routes which trucks currently use to reach the ports-of-entry and I-10” (El Paso Regional Metropolitan Planning Organization 2000). Construction is complete. The remainder of the Inner Loop project is beginning the environmental review process.

Another freeway is planned to connect the northeast portion of Loop 375 with Railroad Drive, Dyer Street, and US 54. In El Paso County, it would be called the Northeast Parkway. While Fort Bliss personnel are actively involved in the planning process for this project, no formal real estate action has been taken (Hall 2003).

An intermodel transportation hub is in the very early planning stages and would be located at the intersection of the new highway through EPIA and Loop 375.

The MPO Transportation Improvement Plan includes several roadway improvements that will benefit the area.

The US 54 main lanes have been increased to a minimum of six lanes from I-10 to the Fort Bliss entrance at Van Buren Ave. TxDOT plans to continue the widening to Hondo Pass Drive in the Northeast, with an eventual extension of the six-lane section to Loop 375 (Woodrow Bean Trans Mountain Drive). This would make the Patriot Freeway (US 54) a minimum of six lanes from I-10 to Trans Mountain. The Transportation Plan also includes the construction of two flyover ramps at U.S. 54 and Fred Wilson, providing easier access to Fort Bliss, Biggs AAF, the Butterfield Trail, Industrial Park, and surrounding areas (El Paso Regional Metropolitan Planning Organization 2000).

The Plan also includes plans to control access to Montana Avenue (U.S. 62/180) and convert Loop 375 south of Montana (Joe Battle Blvd.) into a freeway, with the current roadway serving as the frontage road.

As a result of these improvements, the 2025 congestion projections show a marked reduction in congestion in the ROI. **Table 3-14** provides these projections.

Table 3-14. Projected Levels of Service on Area Roadways, 2025

Roadway	Volume/ Capacity	Level of Service
US 54 (Patriot Freeway) North of Cassidy Road	0.00-1.00	A-D
Loop 375 at Montana Avenue	1.26-1.50	F
Loop 375 at Dyer Street	0.00-1.00	A-D
Loop 375 at US 54	0.00-1.00	A-D
U.S. 62/180 (Montana Avenue) at Hawkins Road	1.26-1.50	F
U.S. 62/180 (Montana Avenue) East of Yarbrough Road	0.00-1.00	A-D
U.S. 62/180 (Montana Avenue) West of Lee Trevino	0.00-1.00	A-D

Note: Levels of Service A - C are generally acceptable; Levels of Service D and F are generally unacceptable. Projection assumes improvements will be made as planned.
Source: El Paso Regional Metropolitan Planning Organization 2000

3.8.2 Roads in the South Training Areas

The South Training Areas contain a web of roads used by military vehicles, utility companies with easements across the area, and general public for recreational purposes. Roads created by El Paso Natural Gas pipelines traverse the South Training Areas. The pipeline to the deep-well injection site follows the alignment of one of these roads. The vast majority of the roads are neither paved nor maintained, useable only by off-highway vehicles. An exception is the paved road serving the EPWU FHWRP.

3.8.3 Railways

Two commercial carriers, the Union Pacific/Southern Pacific and the Burlington Northern and Santa Fe railroads, provide rail service to El Paso. Only the Union Pacific/Southern Pacific provides service to Fort Bliss in the project area. The Union Pacific/Southern Pacific has three lines in the El Paso area: the northeast trackage parallels US 54 along the western boundary of the South Training Area, the west trackage parallels I-10, and the southeast trackage also parallels I-10.

3.8.4 Airports

EPIA is the only airport in the ROI with scheduled airline service. It has two air carrier runways and one general aviation runway. Boardings at EPIA gradually increased from 1,635,282 in 1998 to 1,688,134 in 2000. As was true nationally, boardings fell in 2001 to 1,564,380 and continued to decline in 2002 to 1,449,965.

3.9 CULTURAL RESOURCES

Cultural resources on Fort Bliss include districts, landscapes, sites, buildings, structures, artifacts, and other evidence of human use. These resources can be grouped into three major categories: archaeological resources, architectural/engineering and landscape resources, and traditional resources or traditional cultural properties.

Archaeological resources are locations where human activity measurably altered the earth or left deposits of physical remains (e.g., stone tools, projectile points, bottles).

Architectural/engineering and landscape resources include standing buildings, dams, canals, bridges, designed landscapes, rural landscapes, and other structures or landscapes of historic, aesthetic, or scientific significance. Such resources are generally 50 years of age or older, although military buildings and structures from the Cold War era (1946 to 1989) can be considered significant if they are of exceptional importance to the nation's military history. Cultural landscapes are geographic areas that include related cultural and natural resource features and the spatial relationships among those features.

Traditional resources or traditional cultural properties are associated with cultural practices and beliefs of a living community, are rooted in its history, and are important in maintaining the continuing cultural identity of the community. In the Fort Bliss area, these are usually associated with modern Native American groups. Native American traditional resources may include archaeological sites, locations of significant events, sacred areas, sources of raw materials, and traditional hunting or gathering areas, among other resources.

The ROI for cultural resources includes areas that would be disturbed during construction of proposed project facilities and resources that could be indirectly affected by the proposed project.

3.9.1 Historical Setting

The Fort Bliss area lies within the Jornada Mogollon cultural region (U.S. Army 2000 Volume I). People are known to have inhabited the region for at least 12,000 years. Early inhabitants were small bands of highly mobile hunter-gatherers that followed herds of large animals such as bison and possibly mammoth. Cultural materials from the Paleoindian period have been found in the region around and on Fort Bliss (U.S. Army 2000 Volume I). As the climate grew drier, many of the large game animals became extinct. Beginning about 8,000 years ago, the grassland environment shifted to a drier, desert shrub environment. Use of the region during the Archaic period included semi-permanent camps from which groups traveled into the desert, setting up short-term camps to exploit plants and animals. Cultural materials from this period commonly consist of chipped stone and ground stone tools and debris. The large number of ground stone artifacts suggests a growing reliance on plant resources and less use of game throughout this period. Late in the period (2,000 to 3,000 years ago), there is evidence of domesticated corn and beans in the region (U.S. Army 2000 Volume I). Approximately 300 sites from this period have been identified at Fort Bliss (U.S. Army 2000 Volume I). In the succeeding Formative Period, beginning about 1,700 years ago, people practiced agriculture, lived in small huts, and used undecorated ceramics (Mesilla phase). Later, decorated pottery appeared (Doña Ana phase). The El Paso phase is marked by more permanent, substantial structures (pueblos), agriculture, and locally produced ceramics. Over time, and especially during the late Formative period, there was considerable and increasing interaction, such as trade, among groups in northern New Mexico, western Arizona, Texas, and northern Mexico. At the end of the Formative period, another transition may have taken place: a general return to a mix of hunting, gathering, and agriculture by smaller groups. At Fort Bliss, more than 1,700 sites date to this period (U.S. Army 2000 Volume I).

Since the late 1600s, four Native American groups have lived in or near the Fort Bliss region: the Manso, the Suma, the Tigua, and the Mescalero Apache. Later, the Comanche and the Kiowa also traveled through and used the area. At least two Native American groups occupied the region at the time of first Spanish contact: the Manso and the Suma. The Manso people were present in the area of what is today El Paso and Las Cruces. They joined the Tigua people at missions set up by the Spanish at El Paso. Later, smallpox epidemics and intermarriage with the Tigua ended Manso culture. The Suma were hunter-gatherers and farmers. Their fields were along the Rio Grande or near arroyos where runoff provided sufficient moisture for growing crops. Weakened by Spanish slave raids, drought, and Apache raids, the Suma gradually disappeared (U.S. Army 2000 Volume I).

The Tigua people were brought to the El Paso area from pueblos in northern New Mexico by Spanish fleeing the Pueblo Revolt between 1680 and 1682. Eight hundred Tigua were settled near the Mission Nuestra Señora de Guadalupe El Paso del Norte. Several years later, the Tigua were moved a short distance to Mission Corpus Christi de la Ysleta del Sur. The conditions of these settlements prompted at least two uprisings in 1681 and 1684 (U.S. Army 2000 Volume I). A royal land grant in 1751 set aside lands for the Tigua Indians in what is now the El Paso area.

The Mescalero Apache were also present in the region during the 1600s. The Mescalero lived in the area east of the Rio Grande, from the Sacramento Mountains south into northern Mexico, and east onto the southern Plains. Unlike the sedentary Suma, Jumano, and Tigua, the Mescalero Apache people practiced a semi-nomadic life, moving from the mountains to the basins and plains in seasons when edible wild plants and game became available. Early Spanish contact generated a long-lived animosity between the two groups, and Apache raids on Spanish settlements were frequent. In 1810, a treaty was signed that promised the Mescalero a sizable portion of land. The peace held until the Texas Revolution, when the Mescalero sided with the rebel Texans (U.S. Army 2000 Volume I). As a condition of joining the U.S., all lands were to remain Texan. Therefore, any lands set aside for tribes fell under Texas, rather than U.S., jurisdiction. Texas viewed the Mescalero as a potential problem and did not set aside land for them. After the Mexican-American war and the Gadsden Purchase, when the U.S. acquired New Mexico and Arizona, the remainder of the Mescalero's traditional lands came under U.S. jurisdiction. The influx of settlers and miners and the establishment of roads and forts soon brought the Mescalero into conflict with the Americans. After several years of hostilities, a reservation for the Mescalero was established in the Sacramento Mountains, New Mexico. Title of the lands comprising the reservation was not formally transferred to the Mescalero until 1922 (U.S. Army 2000 Volume I).

The Comanche occupied the region briefly beginning in early 1700. By the mid-1800s they had displaced the Apache and controlled the territory south of the Arkansas River to the Rio Grande settlements. The Kiowa made only sporadic forays into the El Paso region during the same time the Comanche were dominant (U.S. Army 2000 Volume I).

The region that is now New Mexico and West Texas was first visited by Europeans in 1528. Spanish expansion into the region was motivated by mining, ranching, conscription of labor, and missionary activity. Spanish explorers established the Salt Trail in 1647 as a salt supply route connecting Lake Lucero with the Camino Real at El Paso. After Mexican independence, the Mexican government encouraged extensive use of the trail and salt beds. The resource was used well into the 19th century (U.S. Army 2000 Volume I). In 1682, a mission and presidio were established at El Paso del Norte. Repeated Apache raiding during the next century eventually resulted in a concerted effort by the Spanish military to fortify its northern frontier. Mexico achieved independence from Spain in 1821, and El Paso area settlements were incorporated into the State of Chihuahua (U.S. Army 2000 Volume I).

When the Texas Revolution began in 1835, Texas claimed all Mexican lands east and north of the Rio Grande, including the Fort Bliss area. These lands became part of the U.S. in 1848 when the Treaty of

Guadalupe-Hidalgo fixed the boundary between the U.S. and Mexico at the Rio Grande. In addition to the mission area, several small communities became part of the town of El Paso. These included Magoffinsville and a settlement around Hart's Mill, two early locations of Fort Bliss. In 1853, the El Paso Road became part of a federal mail route connecting San Antonio with Santa Fe by way of Franklin and El Paso del Norte (NPS 2002). The El Paso area also served as an important stop on the Butterfield Overland Mail Route, established in 1857 as the first large-scale continental mail service (U.S. Army 2000 Volume I). Initially, the Butterfield Trail followed the Upper Road on the Pecos through the Guadalupe Mountains to El Paso. Water was scarce on this trail, and in 1859 the trail was moved south, reaching El Paso on the Lower Road by way of Fort Davis (NPS 2002). Butterfield discontinued service in 1861.

By the 1840s, silver mining achieved local importance and extensive mining took place in the mountains of the region. Mining booms occurred in the region again beginning in 1905. Ranchers began moving into the area during the late 1860s and early 1870s. However, lack of surface water seriously affected land use and ranchers turned their focus to developing water resources, including building stock tanks, drilling wells, and piping water into the area. The Southern Pacific Railroad reached El Paso from New Mexico in 1881. Oil exploration ventures began in the region in 1919. Thousands of oil and gas claims were filed and a number of exploration companies were formed. However, the area did not become as rich an oil field as expected, and some individuals lost large sums of money on speculation (U.S. Army 2000 Volume I).

U.S. troops were first stationed in the El Paso area near what is now San Jacinto Plaza in downtown El Paso. The post closed in 1851 and was reopened in 1854 when a permanent post, Fort Bliss, was established at the settlement of Magoffinsville. From 1849 to 1861, the post guarded the pass and local residents from Native American attack. Following Texas' secession from the Union in 1861, the fort served briefly as an outpost of the Confederate Army. It was reclaimed by the U.S. Army in 1865. Encroachment by the Rio Grande forced the relocation of the fort to nearby Concordia Ranch (U.S. Army 2000 Volume I). Fort Bliss was closed in 1876 as an economic measure and a new post was built near Hart's Mill in 1880. In 1891, construction was begun on another new fort east of El Paso on 1,000 acres provided by the city on La Noria Mesa, within present-day Fort Bliss. Some of the buildings from this period are still present in the Fort Bliss main cantonment.

During the Mexican Revolution in 1910, Fort Bliss became a major horse cavalry post. The U.S. Government increased troop commitments along the border and in 1913, more than 5,000 Mexican soldiers who had surrendered were held at Fort Bliss. The fort served as a range camp and supply point for patrol operations that culminated in Brigadier General John J. Pershing's Punitive Expedition of 1916 to 1917, following an incursion of Mexican forces into New Mexico. In 1916, President Wilson assigned 112,000 National Guardsmen to border stations, including El Paso. That year, more than 40,000 soldiers were stationed at Fort Bliss, making it temporarily one of the largest military installations in the U.S. (U.S. Army 2000 Volume I).

During World War I, Fort Bliss served as an enlistment post and mobilization point, and several training schools were established. The garrison saw local action when Pancho Villa's forces assaulted Ciudad Juárez in 1919. U.S. forces routed Villa's troops—the last time a large U.S. military contingent was sent into Mexico. Many of the buildings from this period are still present in the main cantonment area. The officers' residence that later became known as the Pershing House was built in 1910 and is now listed in the National Register of Historic Places (NRHP) (U.S. Army 2000 Volume I). Following World War I, Fort Bliss became headquarters for the 1st Bombardment Group, whose mission was to patrol the border by air. In 1925 and 1926, more than 4,000 acres were added to Fort Bliss for Biggs Field, Castner Range, and William Beaumont General Hospital. El Paso Municipal Airport was constructed near Fort Bliss in 1928 following a 1927 visit by Charles Lindbergh who encouraged its establishment (City of El Paso 2001). Fort Bliss purchased 2,700 acres surrounding the main cantonment in 1931 and construction of more than 100 non-commissioned officer family quarters was also undertaken (U.S. Army 2000 Volume I).

During World War II, Fort Bliss served as a troop reception center. The last remaining U.S. horse cavalry unit was disbanded in 1943 and the fort became the national center for artillery. Fort Bliss administered World War II prisoners of war camps at Sunland Park and Logan Heights. The post grew quickly as the need for large parcels of training land became evident. The South Training Areas and other ranges were acquired during this period. The South Training Areas consisted of 118,667 acres north and east of the main post to be used for training the 1st Cavalry Division and other mechanized units. In the South Training Areas, the 1st Cavalry Division conducted infantry training at a complex known as Little Tokyo, a mock Japanese village (U.S. Army 2000 Volume I).

Fort Bliss provided research facilities for the strategic missile program during the early Cold War era, and was designated the Nation's Army Air Defense Center in 1957. The post played an important role in the development of the American missile program, including development of the V-2 rocket and the Anti-Aircraft Artillery Replacement Training Center (U.S. Army 2000 Volume I). McGregor Guided Missile Range in New Mexico was acquired during the Cold War era of the 1950s (U.S. Army 2000 Volume I).

The Basic Combat Training Center was established at Fort Bliss in 1965 to meet the needs of the Vietnam War. Anti-aircraft artillery air defense battalions were also trained there. Training began on the Redeye missile, the first portable, shoulder-fired air defense weapon, in 1967. The U.S. Army Air Defense School provided training in Nike-Hercules, Hawk, Chaparral, and Safeguard missile systems. The German Air Force Air Defense School was established at Fort Bliss in the 1960s (U.S. Army 2000 Volume I). Toward the end of the Cold War, during the 1980s, the Patriot missile system, used during the Persian Gulf War, came online and the Stinger missile replaced the Redeye. Schools at Fort Bliss continue to provide training on a range of air defense weapons including the Patriot, Stinger, and Hawk (U.S. Army 2000 Volume I).

3.9.2 Identified Cultural Resources in the ROI

Since the 1920s, hundreds of cultural resources studies have been conducted on what are now Fort Bliss properties. Investigations have identified more than 15,000 cultural resources on the installation as a whole, the vast majority of which are Native American archaeological sites (U.S. Army 2000 Volume I). In addition, more than 400 historic buildings and structures, and 12 historic landscapes at Fort Bliss have been identified as eligible for the NRHP. No cultural resources in the project area are listed in the National Register.

The project area was inventoried for archaeological resources during a survey of Maneuver Area I (Whalen 1978). Inventory of Maneuver Area I located 1,391 Native American sites: 1,262 camps and 129 residential sites. The 13 Euroamerican sites recorded in Maneuver Area I included a portion of the Butterfield Overland Mail Route (Whalen 1978). The Butterfield Trail passes east to west between proposed desalination plant sites 1 and 2 on the north, and site 3 on the south (Whalen 1978). In addition, the southern portion of Maneuver Area I (including the vicinity of proposed facility location 3) was later selected for a focused study of small Native American camps because of the unusually high density of such sites in the area (Whalen 1980). Both of the potential pipeline routes would pass through a number of archaeological sites. The route that leads northeast to the deep-well injection area contains the densest concentration of sites, although the north-south pipeline route also contains site locations. Archaeological sites are also found along the east-west El Paso Natural Gas easement and the wells collection line. Although the present project area has been inventoried and many resources identified, the resources require evaluation for NRHP eligibility (Bowman 2003). Inventory did not identify architectural resources within the project area (Whalen 1978).

A survey of sacred sites, including ethnographic research, was included in Fort Bliss's Integrated Cultural Resources Management Plan (U.S. Army 2000 Volume I). Traditional resources were not identified within the South Training Areas, but could potentially occur based on past use of the area (U.S. Army 2000 Volume I). Two Native American tribes who live near Fort Bliss today have been identified as having traditional lands encompassing the project area. These tribes are the Mescalero Apache and the Tigua. The Army maintains ongoing consultation with the Tigua and Mescalero Apache to identify traditional resource issues and concerns on Fort Bliss facilities.

The Tigua Tribe "asserts affiliation with the Jornada Mogollon cultural horizon which overlays all of Fort Bliss (and the Hueco Bolson) based on the absorption of Manso and Suma cultural traditions" (U.S. Army 2000 Volume III) and use of the area prior to establishment of the military installation. The Tigua Tribe has identified traditional use of 72 species of plants throughout their claim area (U.S. Army 2000 Volume III). The locations of traditional plants and geologic features are sensitive and are not available to the public. Consultation with Native American groups for the proposed action would identify whether there are traditional resource concerns with regard to specific project locations.

The area surrounding Fort Bliss also falls within the traditional territory of the Mescalero Apache. Carmichael (1994) provides an overview of Mescalero Apache sacred features in the region. Generally, several types of topographic features have spiritual significance, including caves, springs, and certain mountain peaks. To a lesser extent, resource areas containing specific botanical and geological materials used in ceremonies are also considered important by the Mescalero. Consultation efforts related to other undertakings in the region have indicated that the Mescalero may have concerns of a general nature about resources on Fort Bliss (U.S. Army 2000 Volume I).

3.10 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Socioeconomics

The socioeconomic environment of El Paso County is defined by the characteristics of the population such as the growth rate, labor force, employment, income, and other economic indicators. Local taxes and water rates are also considered.

The ROI for socioeconomics is the area where the potential direct and indirect socioeconomic effects of actions associated with the proposed desalination project would occur and where most consequences for local jurisdictions would be expected. Water produced by the desalination plant would be distributed to users within the EPWU service area, and the ROI for all socioeconomic impacts is El Paso County, Texas.

Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. 2000 Census data were used to estimate the number of persons in minority populations and low-income populations living in areas that could potentially be affected by construction and operation of the proposed desalination project. The ROI for environmental justice is the area where adverse effects might occur.

3.10.1 Socioeconomics

3.10.1.1 Demographics

Along with the per capita rate of water consumption, population is a determining factor in the demand for water. **Table 3-15** displays the population and growth rates from 1970 to 2000. The population in the ROI increased over the period 1970 to 2000 from 359,291 persons to 679,622 persons.

Table 3-15. Population and Growth Rate of El Paso County

Population Growth	Year			
	1970	1980	1990	2000
Population	359,291	479,899	591,610	679,622
Population Increase		120,608	111,711	88,012
Percent Growth		34	23	15

Source: U.S. Department of Commerce 2002a.

The rate of population growth in El Paso County steadily declined between 1970 and 2000. The population increase in the county was 19 percent less in the 1990s than in the 1980s. Population forecasts for El Paso County have been developed by Texas A&M University and the Texas Water Development Board (TWDB) (**Table 3-16**). The TWDB forecasts are about 8.5 percent higher than the Texas A&M forecasts.

Table 3-16. Population Forecasts for El Paso County

Year	Projected Population	
	Texas A&M	TWDB
2000	679,622	679,622
2005	737,866	No data
2010	799,936	826,062
2015	864,980	No data
2020	926,760	986,443
2025	985,776	No data
2030	1,043,284	1,127,206
2035	1,098,823	No data
2040	1,150,839	1,248,609

Source: Texas A&M University et al. 2000, 2002; TWDB 2004.

3.10.1.2 Employment and Earnings

Current Employment

Total full- and part-time employment in El Paso County rose from 149,255 jobs in 1970 to 327,289 jobs in 2000 (**Table 3-17**). Employment increased by 43.9 percent in the 1970s; 26.0 percent in the 1980s; and 20.9 percent in the 1990s. County growth rates in manufacturing and trade employment declined in the 1990s, with mining and manufacturing actually losing jobs. In 2000, the Services sector contributed most to total employment in El Paso County, followed by Retail Trade, Government, and Manufacturing.

Table 3-17. Full- and Part-time Employment by Sector in El Paso County

Employment Sector	Year				Percentage Change		
	1970	1980	1990	2000	1970-1980	1980-1990	1990-2000
Agricultural services, forestry, fishing, & other	353	748	1,516	2,110	111.9	102.7	39.2
Mining	172	679	693	514	294.8	2.1	-25.8
Construction	7,205	10,332	12,258	19,022	43.4	18.6	55.2
Manufacturing	23,895	36,422	41,783	39,219	52.4	14.7	-6.1
Transportation and public utilities	8,881	11,641	12,079	18,956	31.1	3.8	56.9
Wholesale trade	7,385	10,133	13,289	14,661	37.2	31.1	10.3
Retail trade	22,883	34,936	46,539	56,419	52.7	33.2	21.2
Finance, insurance, & real estate	8,300	15,813	17,075	20,420	90.5	8.0	19.6
Services	23,317	36,795	61,252	87,898	57.8	66.5	43.5
Government & government enterprises	44,927	56,189	61,252	67,032	25.1	9.0	9.4
Employment	**149,255**	**214,839**	**270,799**	**327,289**	**43.9**	**26.0**	**20.9**

Source: U.S. Department of Commerce 2002b.

The State of Texas projects employment by Workforce Development Area (WDA). The WDA that includes El Paso County also includes Brewster, Culberson, Hudspeth, Jeff Davis, and Presidio counties and is called the Upper Rio Grande Region. El Paso County employees make up 98.5 percent of the WDA employment and dominate WDA projections, thus it is not expected that projections for El Paso County would differ significantly from those of the WDA. Over the period 2000 through 2010, total employment in the WDA is anticipated to increase from 289,790 jobs to 337,710 jobs for a growth rate of 16.5 percent. The highest growth rate is projected for the Services sector at 24.2 percent, followed by Transportation and Public Utilities at 22.1 percent, and Government at 19.4 percent.

The WDA projections are lower than the figures in Table 3-17. Part of the reason for the discrepancy is that the WDA figures do not include military personnel. They also may not contain full-time equivalents for part-time jobs.

Unemployment

In 2000, the unemployment rate for El Paso County was 9.33 percent. In the 1990s, El Paso County unemployment stayed above 8 percent and went almost as high as 12 percent (Texas Workforce Commission 2002).

Earnings

Total earnings paid to workers in El Paso County have increased from $909,976,000 in 1970 to $2,759,923,000 in 1980, $5,532,289,000 in 1990, and $9,325,192,000 in 2000 (**Table 3-18**). The greatest contributions to earnings in 2000 were made by the following industrial sectors: Government (28.1 percent), Services (20.9 percent), Manufacturing (12.4 percent), and Retail Trade (10.2 percent). Overall, earnings increased by 69 percent in the 1990s.

Table 3-18. El Paso County Earnings

Sector	Earnings ($000)				Percent Change 1990-2000
	1970	1980	1990	2000	
Agricultural Services, forestry, fishing, and other	1,604	5,857	17,219	28,380	65
Mining	996	22,950	6,563	17,496	167
Construction	48,458	141,410	218,022	429,097	97
Manufacturing	144,202	461,609	887,292	1,160,248	31
Transportation and public utilities	80,622	267,416	378,841	777,713	105
Wholesale trade	59,009	175,717	332,340	523,726	58
Retail trade	106,391	318,059	593,811	952,054	60
Finance, insurance, and real estate	35,477	119,346	202,602	872,828	331
Services	110,436	395,426	1,161,287	1,946,852	68
Government & government enterprises	322,781	852,133	1,734,312	2,616,798	51
Total Earnings	**909,976**	**2,759,923**	**5,532,289**	**9,325,192**	**69**

Source: U.S. Department of Commerce 2002b

3.10.1.3 Public Finance (EPWU)

The analysis of public finance is limited to the finances of EPWU, which is solely responsible for meeting the costs of construction and operation of the proposed desalination facility. The largest source of revenue for EPWU is from the sale of its water and sewer services. **Table 3-19** displays water and sewer rates in El Paso compared to other water utilities in the southwest. El Paso ranks as the fourth least expensive. A survey of local water utilities in 2001 determined that the EPWU charges the lowest water rates of all local water purveyors (EPWU-PSB 2003b).

Table 3-19. Comparative Residential Water and Sewer Rates

City	Dollars per month in 2002		
	Water	Sewer	Total
Austin	31.73	36.45	68.18
Colorado Springs	42.77	16.09	58.86
Fort Worth	31.36	26.72	58.08
Denver	24.32	31.20	55.52
Dallas	23.59	25.71	49.30
Albuquerque	26.57	18.95	45.52
San Antonio	26.66	15.97	42.63
Tucson	27.91	13.49	41.40
El Paso	**20.62**	**15.83**	**36.45**
Las Cruces	19.84	16.08	35.92
Phoenix	20.82	13.26	34.08
Las Vegas	20.22	12.60	32.82

Average monthly residential bill assuming 12,718 gallons water and 8,229 gallons sewage
Source: EPWU-PSB 2003b

3.10.1.4 Cost of Living

On average, city residents pay 94 percent of the national average for all items (El Paso Chamber of Commerce 2002). This estimate is consistent with the American Chamber of Commerce Researchers Association, which found that El Paso's cost of living was 94.6 percent of the national median of 100 cities in 1997. This Association bases its estimates on housing, grocery, transportation, utilities and health-care costs. In 1997, cost of living ranged from an index value of 88.1 in Weatherford, Oklahoma, to 237.7 in New York City (Elder 1997). As discussed above, water rates are particularly low for EPWU residential customers. El Paso rates were 81 percent of the median rates surveyed (see Table 3-19) (EPWU-PSB 2003b).

3.10.2 Environmental Justice

3.10.2.1 Minority Population

The Bureau of Census defines minorities to include minority race and all Hispanic/Latino populations. Minority race includes Black or African American, American Indian or Alaskan Native, Asian, and Native Hawaiian or other Pacific Islander. Separate categories are designated for Hispanic and Latino persons of minority race and those that are not minority race. **Table 3-20** shows the minority population of El Paso County. In total, 83 percent of the county population is minority as defined by the Bureau of Census.

Table 3-20. Minority and Latino Populations in El Paso County

Population Categories	Number	Percent
Minority:		
Hispanic or Latino, Not Minority Race	509,808	75
Hispanic or Latino Minority Race	22,159	3
Other Minority Race	30,715	5
White or Some Other Race, but Not Hispanic or Latino	116,940	17
Total Population	**679,622**	**100**

Source: U.S. Department of Commerce 2002c

Figure 3-15 shows the location of census tracts in the vicinity of Fort Bliss. Higher than average minority populations occur in census tracts 34.03, 103.03, 103.07, 103.11, 103.12, 103.16, 103.17, 42.01, 42.02, and 43.12. The census tracts south and east of Fort Bliss and southwest of the EPIA have higher than county average proportion of Latino residents. Specifically, tracts 33, 34.01, 43.14, 43.15, 43.16, 103.13, 103.15, 103.20, 103.21, and all tracts south of I-10 have higher than average Latino populations.

Within El Paso County, 5,559 people (or about 0.8 percent of residents) are American Indian or Alaska Native alone, including those who consider themselves Latino. If mixed race persons are included, 7,684 persons (just over 1 percent) claim American Indian or Alaska Native as one of their heritages. Native Americans are fairly evenly spread throughout El Paso County. In the county, only seven census tracts reported more than 100 people who include Native American as part of their heritage.

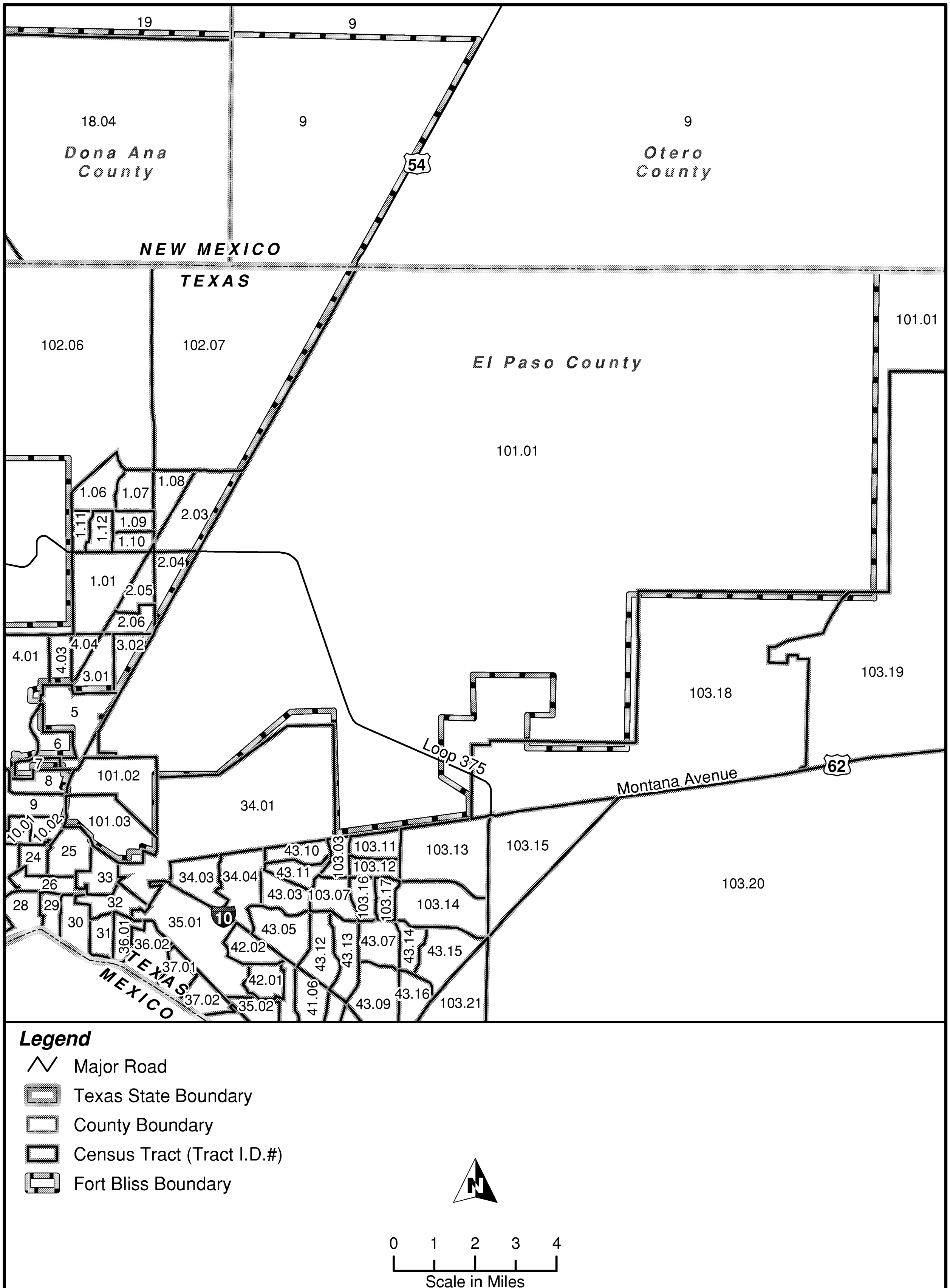


Figure 3-15. Census Tracts in the Vicinity of Fort Bliss

A total of 269 residents who include Native American as part of their heritage live in the two tracts just southeast of the alternative sites under consideration for the proposed desalination plant. They represent about 1 percent of the population of the two tracts. The largest concentration of Native Americans is in census tracts at the far south-southeast end of the city of El Paso. Of this group, more than half report being Latino as well. This area coincides with the Ysleta del Sur pueblo, which was federally recognized as a tribe in 1989.

3.10.2.2 Low-Income Population

According to data from the 2000 census, 158,722 persons (23 percent) of the population of El Paso County lives below the census-defined poverty level. Some county census tracts have no one living in poverty, but some county census tracts have more than 70 percent of the population living in poverty. The poorest tracts are southwest of the Fort Bliss Main Gate and south of I-10.

There are concentrations of people living in poverty in tracts 103.18 and 103.19 south of Fort Bliss and southeast of the proposed deep-well injection site. These tracts fall within the EPWU Sub-Area II (East Montana) service area and are not currently served by a conventional water system. There are 10 Colonias[1] in this service area within census tract 103.19 that include a total of 221 occupied lots and 834 persons, who either purchase water from a truck vendor or haul their own water (EPWU 2002).

[1] A Colonia is defined by the Texas General Government Code, Sub-Chapter Z, paragraph 2306.581 as a "geographic area located in a county some part of which is within 150 miles of the international border of this state and that: (A) has a majority population composed of individuals and families of low income and very low income, based on the general Office of Management and Budget poverty index, and meets the qualifications of an economically distressed areas under Section 17.921, Water Code; or (B) has the physical and economic characteristics of a colonia, as determined by the department."

4 ENVIRONMENTAL CONSEQUENCES

Chapter 4 describes the environmental impacts expected or that have the potential to occur with each of the seven alternatives analyzed in detail as described in Section 2.2. These alternatives include:

- Alternative 1, development of desalination plant Site 1 and deep-well injection of the concentrate
- Alternative 2, development of desalination plant Site 2 and deep-well injection of the concentrate
- Alternative 3, development of desalination plant Site 3 and deep-well injection of the concentrate
- Alternative 4, development of desalination plant Site 1 and disposition of the concentrate in evaporation ponds
- Alternative 5, development of desalination plant Site 2 and disposition of the concentrate in evaporation ponds
- Alternative 6, development of desalination plant Site 3 and disposition of the concentrate in evaporation ponds
- Alternative 7, No Action Alternative

The chapter is organized by the ten resource areas described in Chapter 3. This chapter also summarizes irreversible and irretrievable commitments of resources, the relationship between short-term uses and long-term productivity, cumulative impacts, and unavoidable adverse impacts if the proposed action is implemented.

4.1 GEOLOGY AND SOILS

Impacts from the alternatives on geology and soils were analyzed to determine whether construction activities or operations would alter geologic features, physical features, or topography; cause land subsidence; create unstable soil conditions or severe soil erosion; disturb mineral or geothermal resources; or expose people to the effects of fault rupture, seismic ground shaking, or ground failure. The effects on geology and soils were analyzed by comparing the baseline topography, stratigraphy, soils, mineral resources, landforms, slope stability, and seismic hazard conditions in the project area to the conditions generated by the construction and operation of each alternative. The analysis is based on the potential disturbance of geological features and soil caused by the project and the susceptibility of the project area to geologic hazards. The probability of each alternative encountering geologic hazards was evaluated based on an assessment of the proximity of active faults, frequency and types of seismic events, and the type of soils and their engineering properties.

4.1.1 Alternative 1

4.1.1.1 Desalination Facilities and Operations

Desalination plant Site 1 (process area, administration area, learning center, fence, road, parking lot, and ponding area) would occupy approximately 31 acres, and it was conservatively assumed that virtually the entire site would be disturbed in some way during construction. It is estimated that construction of the access road, pipelines from the feed and blend wells to the desalination plant, and construction of the blend wells themselves would disturb an additional 103 acres.

Geologic Hazards

Subsidence. Aquifer compaction resulting in measurable land subsidence can occur when formation pore pressure is reduced by groundwater withdrawals. Potential subsidence associated with groundwater withdrawals in the El Paso area has been assessed by the National Geodetic Survey (Heywood and Yager 2003). As of 1993, the maximum measured elevation change at a benchmark near downtown El Paso was 0.25 m (0.82 feet), which is consistent with aquifer compression associated with groundwater drawdown. Groundwater levels have declined approximately 147 feet since 1940 due to withdrawals. It is expected that the volume of water that would be pumped from the Hueco Bolson would be the same whether or not the desalination plant is constructed. However, with the desalination project, EPWU pumping would be concentrated in the area around the feed wells (and, to a lesser extent, the blend wells), creating a substantial trough in the groundwater level. The proposed action is expected to cause an additional 90-foot drop in the vicinity of the feed wells after 50 years of pumping (see Section 4.2). Based on past experience in El Paso, this could cause additional ground subsidence. Resulting impacts are likely to be minor because any subsidence would extend over a fairly broad area, minimizing shear effects that could cause structural damage in buildings. The amount of subsidence is likely to be small; extrapolating from the 0.82 feet of subsidence in downtown El Paso associated with a 147-foot groundwater drawdown, the 90-foot drawdown over 50 years projected for the proposed project could be expected to result in subsidence of approximately one-half foot.

Seismic Hazard. The El Paso-Fort Bliss area is in a relatively active tectonic unit, the Rio Grande Rift. On average, a felt earthquake of magnitude 3.0 to 4.0 on the Richter scale occurs near El Paso every 10 years. The last earthquake felt in El Paso occurred on December 8, 1972 (magnitude 3.0) near Newman on the Texas-New Mexico border. Few large earthquakes have been reported in this area, but the probability of earthquakes in this area is higher than in the rest of Texas. The occurrence of two earthquakes with magnitude near 6 in the twentieth century suggests that a magnitude 7 earthquake could occur every few hundred years or so. It is estimated that several earthquakes with magnitudes 5 to 6 on the Richter scale would be expected to occur each century. Moreover, the historical earthquake record and regional geology suggest that even larger earthquakes are possible, at a frequency of about once per 500 years (TDPS 1998).

The plant site would experience moderate damage from an earthquake of intensity 7 or higher on the Modified Mercalli Intensity scale (scale from 1 to 12; the higher the number, the greater the associated ground-shaking intensity and/or damage). In this area, earthquakes pose an appreciable hazard only for poorly built or very sensitive structures. However, an earthquake of magnitude 5.5 or greater could cause personal injury.

In addition, movement on active faults could displace or damage pipelines carrying feed or blend water, finished water, or concentrate. Because the pipelines would be placed in loose soil, sand, and alluvial sediments, it is most likely that any shear stress associated with fault movement would be absorbed before it affected the pipelines. As a result, the probability of active faults breaking pipelines would be low. Should the pipelines break, they would release water from the feed or blend wells, which could cause erosion in the area of the break. The released water would percolate through the soils and cause only short-term, minor changes in soil moisture content. Potential releases from the concentrate pipeline are addressed below in the section on concentrate disposal.

Geologic Resources

The Franklin Mountains are about six miles west of Site 1, so rocks and associated geological features would not be affected by the proposed construction and operation of the desalination plant. Since access to Fort Bliss for commercial mineral exploration and development would continue to be closed, there would be no impact on the availability of mineral and oil and gas resources.

Soils

The soil unit at Site 1 is essentially McNew Sandy Loam. Slope of this soil type is generally low (less than three degrees). The soil type is characterized as well drained and has low runoff. Less than 20 percent of the surface is covered by vegetation. Soils would be disturbed and may be compacted during construction of the plant and the pipelines. Vegetation and soil disturbance would be caused by excavation, and soil compaction would be caused by heavy equipment at the construction site and on temporary access roads. Dust would also be generated. Wind erodibility of the soil unit is high, and due to the sparse natural vegetation and the soil's dry and loose character, wind erosion could be considerable during construction, especially during March and April. Dust suppression techniques would need to be used during construction to minimize fugitive dust emissions. These could include periodic watering of disturbed soil and application of soil stabilizers to disturbed areas that are not being actively worked. Soil compaction could decrease infiltration and water storage capacity, increase runoff, and reduce soil productivity. However, because the area is essentially flat and the soil is well drained, there would be no significant increase in water erosion within the project area.

4.1.1.2 Disposal of Concentrate

Geologic Hazards

Seismic Hazard. Deep-well injection of fluids has been shown to induce earthquakes under certain conditions. The injection of liquids into deep aquifers may trigger earthquakes because of the readjustment of the stress field in the Earth's crust. Any measurable increase in earthquakes due to concentrate injection, however, is expected to be minor and of small magnitude. Any damage from induced earthquakes would likely be localized at the injection site, removed from population centers.

Seismicity induced by hydraulic fracture has been widely studied in the literature (Rutledge and Phillips 2002). Hydraulic fractures can expand to trigger slip on adjacent faults, which could increase earthquake magnitudes. The calculated transmissivity of the injection zone is high — on the order of 320,000 gallon per day per foot. Injection of 3.2 MGD of concentrate would create a one-hour pressure buildup of 14 to 16 feet (TetraTech/NUS 2003). Project engineers believe that no excessive pressure would occur during concentrate injection, and earthquakes caused by buildup of rock pressure or fracturing of rocks are not anticipated to occur during injection activities (Ashworth 2003). Underground injection would be done in accordance with federal and state regulatory requirements, and injection wells would be authorized only where the injection zone is sufficiently porous and permeable that fluids could enter the rock formation without causing an excessive buildup of pressure.

Movement on active faults could displace or damage pipelines carrying the concentrate. Because the pipelines would be placed in loose soil, sand, and alluvial sediments, it is most likely that any shear stress associated with fault movement would be absorbed before it affected the pipelines. As a result, the probability of active faults breaking pipelines would be low. Should the pipelines break, they would release brine concentrate, which could cause erosion in the area of the break. The released concentrate would percolate through the soils and cause long-term increases of concentrations of salts in the soils through which they percolate. The impact of the increased salt concentration in soils would depend on the magnitude of the release. Given the porosity of the soil, the concentrate would tend to percolate down beneath the surface and the surface area affected would be relatively small. If the concentrate reached the surface, however, it could be toxic to existing plants and reduce the ability of vegetation in the affected area to recover. Installation of a pressure monitoring system would detect losses of concentrate from the pipeline and allow action to be taken to remedy the condition.

Geologic Resources

Drilling an injection well would have minimal effects on geology and topography. The geothermal resource is the only resource that could potentially be affected by deep-well injection.

Geothermal Resources. The McGregor geothermal system is north of the concentrate disposal test site across the Texas-New Mexico border (Witcher 1997). Deep-well injection Test Hole 3 is located about 4 miles southeast of the closest geothermal exploratory slimhole, 51-8, drilled by Sandia National Lab (Finger and Jacobson 1997). Although currently available evidence from the test holes drilled in the area of the injection site suggest that a connection is unlikely (Tetra Tech/NUS 2003), a geothermal anomaly occurs between these two wells, about three miles north of Test Hole 3 (MC*i*/LBG-Guyton Associates 2003). Studies indicate that injection of concentrate water into the geothermal field would disturb its temperature gradient. The rate of injection would also alter the temperature patterns of the thermal field. Experiments indicate that at a slow, constant rate of liquid injection into a liquid-filled porous medium, heat is conducted from the far field towards the source. However, at higher rates of injection, an isothermal zone develops close to the injection well (Shaun et al. 1997). Current knowledge about the McGregor geothermal system suggests that the temperature is not high enough to be commercially valuable, but if there is a connection between the injection aquifer and the geothermal system, temperatures of the geothermal resource would be reduced, possibly precluding future use of the resource when better technology is available. Based on the current information, this risk is considered low.

Soils

Installation of the concentrate pipeline from Loop 375 to the deep-well injection site is estimated to disturb approximately 92 acres. The main soil type in the area traversed by the pipeline from the desalination plant to the injection site would be Copia Loamy Fine Sand. This soil type is common in the desert area, forming sand dunes with slopes of 5 to 15 degrees. Vegetation and soil disturbance would be caused by excavation, and soil compaction would be caused by heavy equipment along the pipeline route and on temporary access roads. Dust would also be generated. Wind erodibility of the soil unit is high, and due to the sparse natural vegetation and the soil's dry and loose character, wind erosion could be considerable during construction, especially during March and April. Dust suppression techniques would need to be used during construction to minimize fugitive dust emissions. These could include periodic watering of disturbed soil and/or application of soil stabilizers to disturbed areas that are not being actively worked. Soil compaction could decrease infiltration and water storage capacity, increase runoff, and reduce soil productivity, but only in a narrow corridor along the length of the pipeline.

Because the area disturbed by drilling activities at the injection wells would be very small and localized, the impact on soil would be minimal.

If there were a leak of concentrate from the pipelines, the salinity of the soil in the area of the leak would increase. The magnitude of the impact would depend on the size of the leak.

4.1.2 Alternative 2

4.1.2.1 Desalination Facilities and Operations

The size of desalination plant Site 2 would be identical to Site 1, and the impacts associated with construction and operation of a desalination plant at Site 2 would be the same as those described for

Alternative 1. Soils would be affected as described in Alternative 1. Approximately 99 acres are estimated to be disturbed for the access road, blend wells, and feed and blend well pipelines, slightly less than under Alternative 1.

4.1.2.2 Disposal of Concentrate

The pipeline from Loop 375 to the deep-well injection site would be longer under this alternative than Alternative 1, and installation would disturb approximately 103 acres, about 12 acres more. Soils would be affected as described in Alternative 1.

Deep-well injection of the concentrate would occur at the same location as in Alternative 1, and the impacts of deep-well injection would be the same as those described for Alternative 1.

4.1.3 Alternative 3

4.1.3.1 Desalination Facilities and Operations

The size of desalination plant Site 3 would be the same as Site 1, and the impacts associated with construction and operation of a desalination plant at Site 3 would be the same as those described for Alternative 1. Soils would be affected as described in Alternative 1Approximately 92 acres are estimated to be disturbed for the access road, blend wells, and feed and blend well pipelines, which is less than under Alternative 1 or 2.

4.1.3.2 Disposal of Concentrate

The length of pipeline from Loop 375 to the deep-well injection site would be about the same as Alternative 2. Soils would be affected as described in Alternative 1, but along the longer route.

Deep-well injection of the concentrate would occur at the same location as in Alternative 1, and the impacts of deep-well injection would be the same as those described for Alternative 1.

4.1.4 Alternative 4

4.1.4.1 Desalination Facilities and Operations

The desalination facility would be same as in Alternative 1, and the impacts of construction and operation of the facility, access road, blend wells, and feed and blend well pipelines would be the same as those described for Alternative 1.

4.1.4.2 Disposal of Concentrate

Construction of the evaporation ponds that would be used for disposal of the concentrate under this alternative would disturb approximately 749 acres. After construction, about 680.5 acres of new ponds would be created. Installation of the concentrate pipeline from Loop 375 to the evaporation ponds would disturb approximately 63 additional acres.

Geologic Hazards

Seismic Hazard. Seismic activity in the area could pose a slight risk to the integrity of the evaporation ponds, which would be lined. The liner would stretch or fold as ground movement occurred. Only with a severe earthquake would catastrophic failure of a pond's liner be likely. Should a liner failure occur, soil salinity would be increased by the concentrate. The magnitude and extent of the area affected would depend on the amount of concentrate in the pond and the salt concentration of the concentrate.

An earthquake could displace or damage pipelines carrying the concentrate from the desalination plant to the ponds. Because the pipelines would be placed in loose soil, sand, and alluvial sediments, it is most likely that any shear stress associated with ground movement would be absorbed before it affected the pipelines. As a result, the probability of ground movement breaking pipelines would be very low. Should the pipelines break, they would release concentrate, which could cause erosion in the area of the break. The released concentrate would percolate through the soils and increase the salinity of the area affected.

Geologic Resources

Because the evaporation ponds would be located in the Hueco Bolson Basin on alluvial sediments, no unique geological features would be affected by construction and operation of the evaporation ponds. No mineral or oil and gas resources would be affected.

Soils

It is estimated that construction of the evaporation ponds could involve excavation of as much as 16.5 million cubic yards of soil, and installation of 30 million square feet of lining. The soil types in the pond area include McNew sandy loam, Pendero fine sand, and Vavalry loamy fine sand. Wind erodibility of all three soil types is high. The effects of wind erosion during pond construction would be minimized by the use of proper compaction and stabilization measures.

If the ponds leaked, the concentrate would infiltrate downward into the soil underneath, increasing the concentration of salts. This would result in a long-term increase in soil salinity. Leaks might occur with puncture of a pond’s liner (during removal of the solids for disposal) and subsequent filling of the pond with new concentrate, or overtopping of a protective berm. The magnitude and extent of the resulting change in soil condition would depend on the magnitude and duration of the leak.

Leaking of concentrate from pipelines would also increase the salinity of the soil in the area of the leak. The magnitude of the impact would depend on the size of the leak.

4.1.5 Alternative 5

4.1.5.1 Desalination Facilities and Operations

The desalination facility under Alternative 5 would be the same as in Alternative 2, and the impacts of construction and operation of the facility, access road, blend wells, and feed and blend well pipelines would be the same as those described for Alternatives 1 and 2.

4.1.5.2 Disposal of Concentrate

Under Alternative 5, the evaporation ponds would be located at the same site as in Alternative 4, but the pipeline from Loop 375 would be slightly longer than in Alternative 4. Installation of the concentrate pipeline is estimated to disturb about 3 acres more. Soils would be affected as described for Alternative 4.

4.1.6 Alternative 6

4.1.6.1 Desalination Facilities and Operations

The desalination facility under Alternative 6 would be at the same as for Alternative 3, and the impacts of construction and operation of the facility, access road, blend wells, and feed and blend well pipelines would be the same as those described for Alternatives 1 and 3.

4.1.6.2 Disposal of Concentrate

The impacts from the evaporation ponds and concentrate pipeline under Alternative 6 would be same as Alternative 5.

4.1.7 No Action Alternative

If the No Action Alternative were selected, there would be no impacts associated with the construction and operation of the desalination plant and concentrate disposal facilities on Fort Bliss land. If similar facilities were constructed elsewhere, the impacts could be expected to be similar to those reported for the action alternatives.

4.1.8 Mitigation Measures

Mitigation measures for the action alternatives include:

- Use of dust suppression techniques such as watering and application of soil stabilizers during construction of the desalination plant and pipelines to minimize fugitive dust (all action alternatives).

- Installation of pressure monitors in the concentrate pipelines to detect leaks, coupled with manually operated valves every 3,000 feet along the pipeline, to minimize soil contamination should there be a leak or catastrophic failure (all action alternatives).

Installation of a leak detection system under the evaporation ponds to allow early detection and corrective action should leaks occur (Alternatives 4, 5, and 6).

4.2 WATER RESOURCES

The impacts of the alternatives on water resources were analyzed to determine whether construction activities or operations would cause a change in the quality, quantity, or availability of water resources. The effects on water resources were evaluated by comparing the groundwater quality, movement, and drawdown in the Hueco Bolson Aquifer in the vicinity of Fort Bliss with and without the project. The impacts of leaks or failure in pipes or evaporation ponds were evaluated by determining if the leaked water had chemical concentrations higher or lower than the shallow aquifer underlying the site of the leak or failure. None of the alternatives is expected to have an impact on surface water.

4.2.1 Alternative 1

4.2.1.1 Desalination Facilities and Operations

The primary impact of the proposed desalination project on water resources would be from feed and blend well production on the movement of brackish groundwater and aquifer "drawdown." Drawdown is a lowering of the water table over time as a result of pumping large quantities of water out of an aquifer.

There is currently a drawdown from the use of the existing wells that draw from the Hueco Bolson. The physical location of the desalination plant and piping facilities would not impact water resources.

Water supply management of groundwater resources in the El Paso region has been evaluated with groundwater models (Orr and Risser 1992; Groschen 1994; Heywood and Yager 2003). Model simulations indicate that baseline (pre-production, circa 1920) groundwater flow was from north to south following the curved geometry of the Hueco Bolson. Increased groundwater production at pumping centers in El Paso and Ciudad Juárez began interrupting the southerly flow pattern in the late 1950s.

The impact of the proposed desalination plant operation on groundwater movement and water quality in the El Paso area was evaluated by EPWU (EPWU and USACE 2003). Modeling was performed to predict the effect of 50 years of pumping from the feed and blend wells. The model results show that the resulting drawdown would alter groundwater flow direction and hydraulic gradients. The modeling assumed 40 years of normal conditions, during which EPWU would pump 40,000 AF/year, and 10 years of drought conditions, during which EPWU would pump 75,000 AF/year. After 50 years, this would result in southerly-directed groundwater movement west of the desalination plant and the development of a localized groundwater trough (deeper area of drawdown) around the feed wells and the new blend wells. Because EPWU currently plans to pump the same total quantity of water from the Hueco Bolson with or without the proposed desalination project, the increased pumping from the feed and blend wells is expected to be offset by decreased pumping from other EPWU wells in the city. This would reduce the groundwater drawdown in the vicinity of those wells and have the beneficial effect of intercepting the flow of brackish groundwater from the northeast, maximizing the availability of fresh water to wells west of the desalination plant (EPWU and USACE 2003). While the modeling considered the effects on drawdown in general and the Fort Bliss wells in particular, it did not provide estimates of drawdown on wells neighboring the blend wells or estimate changes in water quality that would result from pumping the blend wells (EPWU and USACE 2003).

Figure 4-1 and **Figure 4-2** depict the projected drawdown in the Hueco Bolson Aquifer after 50 years of pumping with the proposed desalination project (Figure 4-1) and under the No Action Alternative (Figure 4-2). **Figure 4-3** shows the difference in drawdown between the two. The negative numbers in Figure 4-3 indicate locations where the drawdown would be less with the proposed project because of the planned decrease in pumping from existing EPWU wells. By reducing the pumpage of fresh water, the project would slow down the intrusion of saline water in the area of Fort Bliss' existing water wells. Conversely, the positive numbers in Figure 4-3 show that the proposed project would increase drawdown in the vicinity of the feed wells and proposed blend wells. The result would be up to 60 feet additional drawdown around the feed wells (see Figure 4-3) that, when added to the 30-foot drawdown projected without the desalination project (see Figure 4-2), would create a trough in the groundwater of up to 90 feet below current levels (see Figure 4-1). A similar but less pronounced groundwater trough would be created along Loop 375 where the blend wells would be located. These troughs would be underground and not visible above ground (see Section 4.1 for discussion of possible subsidence). Appendix F contains maps showing the comparative groundwater elevations under current conditions, with the proposed project, and under the No Action Alternative.

Moving groundwater withdrawals to the feed and blend wells would prolong the availability of the freshwater resource by using higher salinity water that would otherwise be unsuitable as drinking water. It would not adversely impact groundwater availability to Ciudad Juárez, but might benefit groundwater quality through the interception of southwestward-directed brackish flow. The modeling analyses conducted by EPWU assessed the impacts from EPWU, Fort Bliss, and Ciudad Juárez groundwater withdrawals on groundwater flows but did not consider the effects of other groundwater withdrawals from the Hueco Bolson (for industrial, municipal, and irrigation purposes). The north-to-south groundwater flow, however, indicates that wells more than a few miles west or east of the blend and feed wells are unlikely to affect or be affected by the proposed action.

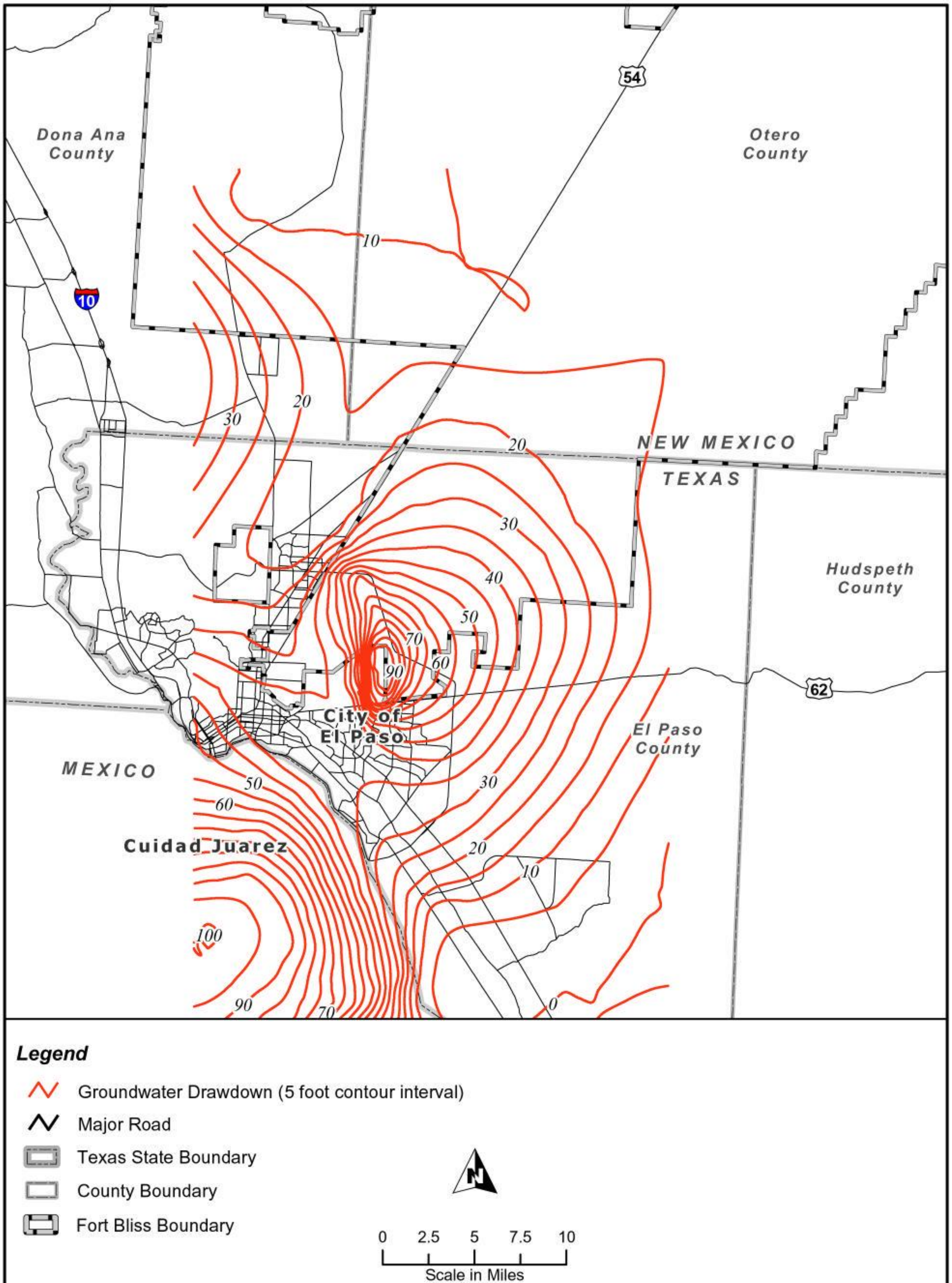


Figure 4-1. Projected Drawdown in Hueco Bolson Aquifer after 50 Years of Pumping from Feed and Proposed Blend Wells

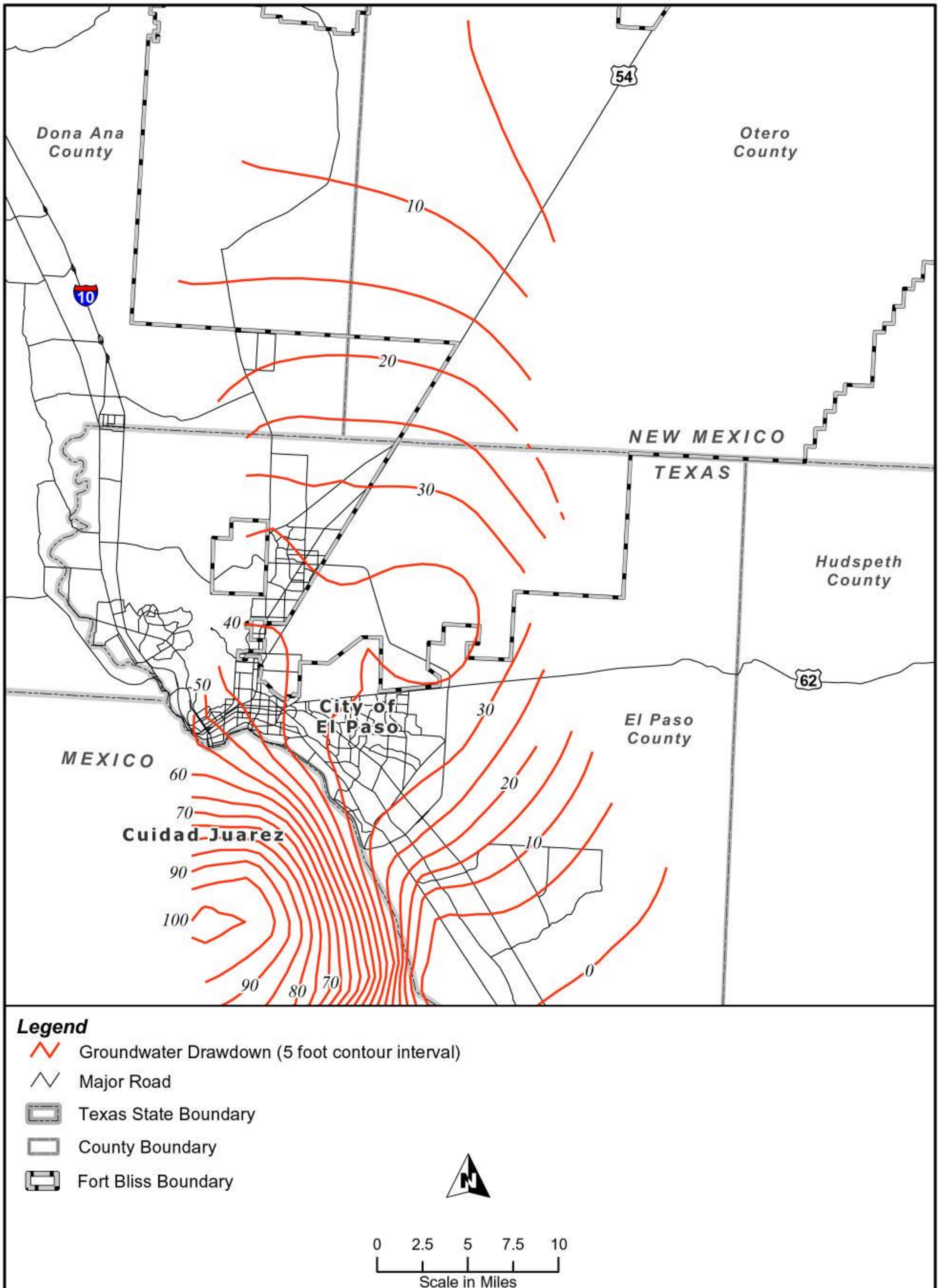


Figure 4-2. Drawdown in Hueco Bolson Aquifer after 50 Years of Pumping under the No Action Alternative

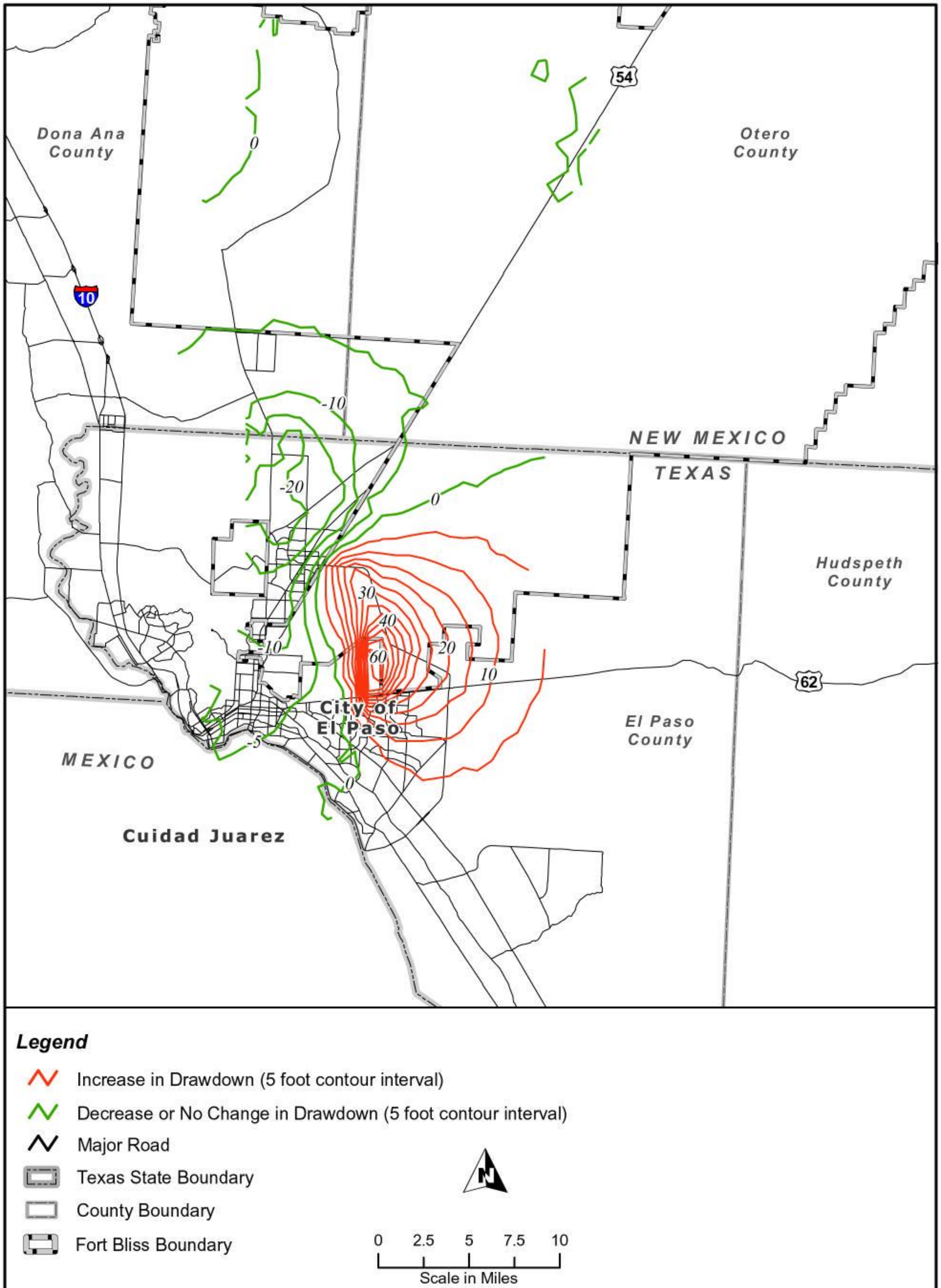


Figure 4-3. Difference in Drawdown Between the Proposed Desalination Project and the No Action Alternative after 50 Years of Pumping

Groundwater quality in the aquifer will be affected by redirection of hydraulic gradients and flow patterns associated with groundwater pumping, with or without the desalination project. Chloride and other dissolved solids will increase as long as water is pumped from the bolson. Preliminary estimates of the rate of salinity increase without the proposed desalination project indicate that chloride concentrations exceeding 250 mg/l would initially occur in the most northern, southern, and eastern existing water supply wells (EPWU 2003d). Chloride and dissolved solids concentrations would increase in the blend and feed wells over time due to the movement of poorer quality water from the northeast. Saline water in the Rio Grande alluvium has been identified (Groschen 1994) as a principal source of saline water intrusion into shallow fresh water. The shallow aquifers above the depth of the blend and feed wells (842 to 1,192 feet) would continue to be degraded by saline water flowing horizontally from higher salinity sources.

4.2.1.2 Disposal of Concentrate

The primary water resources concern associated with disposal of concentrate by deep-well injection is the potential for degradation of existing USDWs overlying or down-gradient of the injection zone. UIC regulations require the injection zone to be able to accept and contain the projected volume of injected concentrate in order to protect USDWs. In addition, these regulations require that the concentrate be compatible with the existing groundwater in the injection zone.

The target injection zone is Fusselman limestone at depths of 2,230 to 2,870 feet below land surface (BLS). Approximately 1,625 to 2,375 feet of Pennsylvanian limestone and shale overlie the Fusselman limestone and vertically isolate the injection zone from shallower aquifers (TetraTech/NUS 2003). Vertical isolation is indicated by the fact that the groundwater in the Fusselman limestone is under artesian pressure, yet shallower formations are not (Hutchison and Granillo 2004). It is inferred that if the injection zone were not confined, the pressure would have equalized with connected areas.

Based on knowledge of the geology of the area developed through a gravity study that was interpreted using published information on faults (Keller et al. 2004), Hutchison and Granillo (2004) developed several estimates of the conductivity and storage capacity of the injection zone from a single injection test at Test Well 3, the well farthest north in the injection site area. Some estimates were eliminated because they were impossible or inconsistent with known information. The estimates that appeared reasonable were then used to project the area over which the injected concentrate would pool by one foot or more after 30 years of injection.

For all model runs using reasonable estimates of conductivity and storage capacity, the injected water was predicted to be contained in an area on the order of 4-5 miles long and 1-2 miles wide around the injection sites. Each model run showed injected water entering New Mexico; all injection sites modeled were within a mile or two of the New Mexico border. The model did not predict that injected water would leave the boundaries of Fort Bliss (South Training Areas and McGregor Range).

These preliminary estimates and results will be refined in further injection testing at a new injection well to be completed in mid 2004. Further testing is likely to better determine the conductivity of the Fusselman limestone and may aid in refining estimates of conductivities of other potentially affected formations. It may not establish, however, whether existing faults would confine the injected concentrate, allow the concentrate to flow over a larger area, or act as conduits through which other formations could be affected. The results of further testing will not be available until after publication of this Draft EIS.

Analysis of groundwater obtained from the injection zone (**Table 4-1**) indicates TDS ranging from 6,600 to 8,400 mg/l and chloride levels at 1,200 to 4,900 mg/l (TetraTech/NUS 2003). In a pilot study conducted on a feed water sample taken in October 2003 from one well, the feed water was found to have a TDS of 1,460 mg/l and the concentrate to have a TDS of 7,030 mg/l. EPWU estimates that, overall, the feed water will have an average TDS of 1,054 mg/l when the desalination plant first comes on line. The TDS concentration is expected to increase over time as the feed water becomes more saline. Current best estimates are that, in 20 years, the feed water TDS would be approximately 1,700 mg/l. The level of TDS in the concentrate would depend on the effectiveness of the RO membranes (which varies with age). When the desalination plant first comes on line, current estimates are that that the RO modules in the plant would recover about 85 percent of the water and the membranes would remove about 92 percent of the TDS. Using those estimates, the resulting TDS in the concentrate is projected to be about 6,500 mg/l. This is projected to increase to 10,200 mg/l over 20 years (Trzcinski 2004b). Based on these estimates, the TDS levels in the later years would be somewhat higher than the existing TDS levels of the groundwater in the injection zone. In the above-mentioned pilot study, the level of chloride in the feed water was 633 mg/l and 2,930 mg/l in the concentrate (Trzcinski 2004b). Extrapolating from those data, the chloride levels would be expected to range from about 2,000 to 4,200 mg/l, which would generally be within the range found in the injection zone.

Table 4-1. Water Quality, Deep-Well Injection Site

	TDS (mg/l)	Chloride (mg/l)
Quaternary sediment	6,600	2,900 – 3,300
Pennsylvanian Shale/Limestone	7,000 – 8,400	1,200 – 4,700
Fusselman Limestone	7,600 – 8,300	3,900 - 4,900

mg/l = milligrams per liter
TDS = Total Dissolved Solids
Source: TetraTech/NUS 2003

The injected concentrate may be required to be similar to the chemical composition of the existing water in the injection zone to preclude chemical reactions that could affect the formation and to obtain regulatory approval (see Appendices B and C). Brackish water would be added to the concentrate as necessary to reduce TSD and chloride levels.

Leakage associated with breaches in the concentrate transportation pipeline could locally affect any shallow USDWs that might exist between the desalination plant and the injection site, locally increasing the salinity of these aquifers.

If leaks or catastrophic breaks occurred in the pipeline carrying the concentrate from the desalination plant to the injection site, any surface aquifers underlying the pipeline could be contaminated. Since there are no USDWs that occur in this area, the impact would likely be small.

4.2.2 Alternative 2

The environmental effects of desalination production and concentrate disposal through deep-well injection under Alternative 2 would be the same as those described for Alternative 1. The physical location of the desalination plant (1.2 miles south of the Site 1) and the piping facilities would not change the impacts on available water resources described for Alternative 1.

4.2.3 Alternative 3

The environmental effects of desalination production and concentrate disposal through deep-well injection under Alternative 2 would be the same as those described for Alternative 1. The physical location of the desalination plant (2.9 miles south of Site 1) and the piping facilities would not change the impacts on available water resources described for Alternative 1.

4.2.4 Alternative 4

4.2.4.1 Desalination Facilities and Operations

Environmental impacts on water resources associated with groundwater production under Alternative 4 would be the same as those described for Alternative 1.

4.2.4.2 Disposal of Concentrate

Under Alternative 4, concentrate produced from desalination would be disposed of by piping it to evaporation ponds located at and adjacent to the FHWRP site. This area is underlain by alluvium (gravel, sand, clay, and silt) of the Hueco Bolson. Locally, the groundwater flow system is affected by runoff infiltration at the base of the Franklin Mountains, stream flow from the Rio Grande, and groundwater flow from the north. Additional sources of recharge in the vicinity of the evaporation pond site include Hueco Bolson Recharge Project injection wells, irrigation-related seepage, and seepage from unlined FHWRP oxidation ponds (Buszka et al. 1994). The depth to groundwater beneath the evaporation pond site is approximately 300 feet BLS. A water table mound is assumed to exist beneath the existing FHWRP oxidation ponds (Buszka et al 1994).

Because the evaporation ponds would be fully lined, there would be no effect on groundwater except in the event of a failure or breach of the pond liner or berm, leaks from or failure of surface/subsurface piping, or the highly unlikely catastrophic overtopping of the pond berm under severe conditions. Should a release occur, depending on the amount and composition of the concentrate released, the chemical concentrations of the water in the shallow aquifer underlying the ponds could increase substantially. The magnitude and severity of the change would depend on the chemical concentrations in the evaporation pond and the extent of the leak or overtopping. Groundwater monitoring in the area of the ponds would be necessary to detect any loss of concentrate from the ponds.

4.2.5 Alternative 5

The environmental effects of desalination production and concentrate disposal through evaporation under Alternative 5 would be the same as described for Alternative 4. The physical location of the desalination plant (1.2 miles south of Site 1) and piping facilities would not change the impacts described for Alternative 4.

4.2.6 Alternative 6

The environmental effects of desalination production and concentrate disposal through evaporation under Alternative 6 would be the same as described for Alternative 4. The physical location of the desalination plant (2.9 miles south of Site 1) and piping facilities would not change the impacts described for Alternative 4.

4.2.7 No Action Alternative

Under the No Action Alternative, the desalination plant, blend wells, and concentrate disposal facilities would not be built on Fort Bliss land. Groundwater resources would continue to be used as they are now. The volume of groundwater taken from the Hueco Bolson is expected to be the same as under the action alternatives (1-6), except it would draw from freshwater sources, and the blend wells would not be used. EPWU would continue to pump from its existing wells, and the current drawdown of the aquifer would also continue. Figure 4-2 shows the projected drawdown after 50 years of pumping, assuming the same total volume of pumping as the proposed action (40 years at 40,000 AF/year and 10 years at 75,000

AF/year), except from freshwater supplies instead of the brackish water in the bolson. This information is primarily provided for comparison purposes, as it is uncertain that freshwater supplies in the bolson would be available for 50 years. Salinity increases are expected in many of the existing EPWU wells and eventually affect Fort Bliss wells (Hutchison and Granillo 2004).

4.2.8 Mitigation Measures

Mitigation measures for the action alternatives include:

- Installation of pressure monitors in the concentrate pipelines to allow early detection of leaks or catastrophic failure so that corrective action can be taken (all action alternatives).

- Development of an emergency action plan to respond to any equipment failure to minimize the release of concentrate into the environment (all action alternatives). Further evaluation of the presence or absence of any connection between the injection zone and other aquifers during deep-well injectivity tests to verify containment of the concentrate (Alternatives 1, 2, and 3).

Groundwater monitoring in the area of the evaporation ponds to allow detection of leaks so corrective action can be taken.

4.3 UTILITIES AND SERVICES

Impacts from the proposed action and alternatives on utilities and services were assessed to determine the extent to which proposed operations would appreciably change the ability of a utility or service provider to serve its customers. Information on potable water supply was provided by EPWU. The projected potable water output and electrical consumption at the proposed desalination plant was obtained from the EPWU Desalination Facility Preliminary Design (MC*i*/CDM 2003). Existing electricity demand in the ROI and substation information was obtained from El Paso Electric (Gonzales 2004).

4.3.1 Alternative 1

4.3.1.1 Desalination Facilities and Operations

Potable Water

There would be no short-term change in the potable water supply in the ROI (the City of El Paso area served by EPWU) associated with the desalination project. Upon startup, other wells in the Hueco Bolson that are currently used to provide potable water would be deactivated or operate under reduced pumping schedules, so the rate of water produced from the bolson would remain the same as is currently produced. However, the desalination plant is expected to extend the life of freshwater supplies from the Hueco Bolson.

Wastewater

Under Alternative 1, there would be a negligible impact on EPWU wastewater treatment systems related to construction and operation of the desalination plant. The concentrate generated by the desalination process would not be sent for treatment or disposal to EPWU wastewater treatment works, and the domestic sewage generated by workers at the new facilities would be negligible.

Solid Waste

Under Alternative 1, there would be no discernible impact on the City of El Paso's solid waste facilities related to construction and operation of the desalination plant. Construction solid wastes would be negligible in comparison to the current input to the two city landfills of 1,700 tons per day. During desalination plant operation, solid wastes are expected to be negligible, consisting of only minor office waste, minor packaging wastes, and used cartridge filters (generation rate not estimated) from the desalination process.

Electricity

Alternative 1 would increase electricity demand by 4.5 MVA. This new demand would represent a 0.3 percent increase over the 2003 EPEC peak electrical demand of 1,308 MVA. EPEC currently has a generating capacity of 1,500 megawatts, so there would be no requirement for additional generating capacity. No new electrical substations would be needed to meet the electrical demand of the desalination facility. Substations in the immediate area (Butterfield-11, Scotsfield-14, and Vista-13) could be used to supply 4.5 MVA to the desalination plant, according to EPEC personnel (Gonzales 2004). Some power demand might be off-loaded to other nearby substations or the feeder capacity at one of these three substations might be increased.

4.3.1.2 Disposal of Concentrate

The disposal of concentrate through deep-well injection would have no impact on potable water supply, wastewater systems, or solid waste facilities. There would be a negligible increase in electricity demand. Power requirements for pumping and deep-well injection would be very small in relation to that required for the desalination process.

4.3.2 Alternative 2

This alternative differs from Alternative 1 only in the location of the desalination plant. The environmental consequences with respect to utilities and services for this alternative would be the same as those described for Alternative 1.

4.3.3 Alternative 3

This alternative differs from Alternative 1 only in the location of the desalination plant. The environmental consequences with respect to utilities and services for this alternative would be the same as described for Alternative 1.

4.3.4 Alternative 4

4.3.4.1 Desalination Facilities and Operations

The impacts from proposed desalination facilities and operations would be the same as described for Alternative 1.

4.3.4.2 Disposal of Concentrate

The disposal of concentrate in evaporation ponds would have no impact on potable water supply or wastewater systems.

Under Alternative 4, there would be an increased generation of solid waste in the form of salts from the evaporation pond facility. Evaporation of the concentrate would result in a solid waste stream of approximately 100 tons per day. Although the solid would be predominately salt, it would have relatively high concentration of metals and would not be suitable as a table salt. There are numerous alternative sources of high-quality salt for use in industrial processes, so it is unlikely that it could be used by industry in major quantities. Also, since there is only a limited market for use of salt as a road deicer in more northern areas, and there are more economical sources of salt for this purpose, it is not expected that any appreciable quantity of this solid waste could be sold or reused. The only apparently feasible alternative for disposal would be in a landfill. State and federal landfill regulations require that only non-hazardous wastes be placed in a non-hazardous waste landfill (RCRA Subtitle D landfill). Currently, this solid waste is not expected to be hazardous; however, it would require periodic TCLP testing to demonstrate that it is not toxic (see preliminary TCLP analysis in Table 2-1). This solid waste disposal would represent a 6 percent increase over the current City of El Paso daily solid waste disposal rate of 1,700 tpd. While it would be a relatively modest increase, it would further exacerbate El Paso's solid waste disposal capacity issues.

Disposal of concentrate in evaporation ponds would have a negligible impact on electricity demand. The power required to pump concentrate to the disposal pond would be very small compared to the power required for the desalination operation.

4.3.5 Alternative 5

This alternative differs from Alternative 4 only in the location of the desalination plant. The environmental consequences with respect to utilities and services for this alternative would be the same as those described for Alternative 4.

4.3.6 Alternative 6

This alternative differs from Alternative 4 only in the location of the desalination plant. The environmental consequences with respect to utilities and services for this alternative would be the same as those described for Alternative 4.

4.3.7 No Action Alternative

Under the No Action Alternative, the impacts on utilities or services from construction and operation of the desalination facilities and concentrate disposal on Fort Bliss land would not occur. Water would continue to be supplied from freshwater sources in the Hueco Bolson, as well as other existing and planned sources. If a desalination facility were developed elsewhere, the impact would be similar to those described for the action alternatives.

4.3.8 Mitigation Measures

No mitigation measures are identified for utilities and services.

4.4 HAZARDOUS MATERIALS, HAZARDOUS WASTE, AND SAFETY

Hazardous Materials and Waste

The assessment of impacts from solid and hazardous materials and waste management focuses on how and to what degree the proposed action and the alternatives would affect hazardous materials usage and management, hazardous waste generation and management, and waste disposal.

Safety

Safety impacts were assessed according to the potential for project-related construction and operations to increase or decrease safety risks to personnel, the public, or property. Proposed activities were considered to determine whether or not additional or unique safety risks would be associated with their undertaking.

4.4.1 Alternative 1

4.4.1.1 Desalination Facilities and Operations

Hazardous Materials and Waste

Hazardous Materials. During construction of the proposed desalination facility, small quantities of petroleum, oil, lubricants, paints and solvents would be present on the site. The quantities and types of materials would be similar to those found on any site supporting the construction of an industrial facility. Transport, storage, use, and disposal of these materials would be in accordance with applicable federal and state requirements, and management and response actions would be detailed in a Spill Prevention and Control Plan.

During operation of the proposed facility, chemical pre- and post-treatment of the water would be required. These processes are typical of all conventional water treatment facilities, including desalination plants, and effective procedures have been established to contain the chemicals used and control any unintentional release that could result in human or environmental exposure. The chemicals that would be used in desalination processes are sulfuric acid, an antiscalant (such as Pretreat Plus™ Y2K), sodium hydroxide (caustic soda), sodium hypochlorite, and a corrosion inhibitor. The hazardous properties, if any, and potential effects of each are described in the following paragraphs. However, these chemicals are routinely used in potable water processing facilities throughout the U.S. and are not unique to desalination plants; many manufacturing facilities and most water treatment facilities use them in their processes. Thus, appropriate handling procedures are well understood. The use of these chemicals would be in accordance with applicable federal and state requirements that would preclude them from presenting a hazard to workers at the plant or to the general public. Sulfuric acid would be added to the feed water to convert carbonate and bicarbonate alkalinity to carbonic acid, reducing the potential for calcium carbonate scaling (MC*i*/CDM 2003). Concentrated sulfuric acid is a highly corrosive substance that presents a severe health hazard. It is a clear, colorless, oily liquid. The chemical itself is nonflammable, but introducing water into large quantities of the acid or allowing diluted acid to react with metal can result in the generation of hydrogen gas, which is highly explosive (MSDS 2004a). Exposure can result from inhalation, ingestion, or absorption through the skin. Inhalation of sulfuric acid mists can damage the respiratory tract and lungs. Concentrated sulfuric acid is a strong dehydrating agent that will quickly damage human tissue. Eye injury can be severe and permanent (MSDS 2004a).

An antiscalant such as Pretreat Plus™ Y2K would be added to the feed water to reduce the probability of iron, silica, barium, carbonate, and calcium sulfate scaling (MC*i*/CDM 2003). Expected concentration in the feed water would be 19 mg/l; expected concentration in the concentrate would be 29 mg/l (Trzcinski 2004b). At these concentrations, there would be no appreciable hazard. Pretreat Plus™ Y2K is primarily phosphoric acid combined with phosphonic acids. None of the components is flammable, but when the undiluted product is heated to dryness, it can release hazardous phosphorus oxides and phosphine gas. Similar chemicals can be released upon contact with strong oxidants. Contact with the undiluted product can result in burns of mucous membranes, the respiratory tract, eyes, and skin, depending on the nature (inhalation, external contact) and duration of the contact. Ingestion would result in irritation or possible burns of the digestive tract (King Lee Technologies 2000).

A sodium hydroxide solution would be added to the blended product water to manage the alkaline/acid balance of the water (MC*i*/CDM 2003). Sodium hydroxide (Caustic Soda) is a hazardous substance that presents a severe health hazard. The substance itself is nonflammable and will not support combustion. However, the reaction of sodium hydroxide with a number of other materials can generate sufficient heat to spontaneously ignite nearby combustible materials (MSDS 2004b). Exposure can result from inhalation, ingestion, or absorption through the skin. Inhalation of sodium hydroxide will cause burns to the nose, throat, and lungs. Ingestion may cause severe pain, burning of the mouth, throat, and esophagus, vomiting, diarrhea, collapse, and possibly death. Contact with the eyes will cause irritation or severe burns depending on the concentration and duration of exposure. In severe cases, ulceration and blindness may occur. Skin contact will cause severe burns with deep ulceration and penetration to the deeper skin layers (MSDS 2004b).

Sodium hypochlorite would be added to the blended water as a disinfectant. Sodium hypochlorite is a strong oxidant and is corrosive. It has a poisonous vapor that can damage the respiratory tract. Increasing doses or prolonged exposure can cause coughing, runny nose, bronchopneumonia, headaches, breathing difficulty, pulmonary edema, and lung injury. Ingestion causes burns, abdominal cramps, nausea, vomiting, lowered blood pressure, diarrhea, and shock. Coma, shock, and death may occur with ingestion (MSDS 2004c).

Corrosion inhibitors may be added to the blended product water to prevent leaching of lead, copper, zinc, or iron from pipes, color in the water, or a metallic taste in the water (MC*i*/CDM 2003). There are numerous commercial types of corrosion inhibitors available, each developed by its manufacturer. No specific brand has been selected, so it is not currently possible to specify the chemicals that would be involved. Any corrosion inhibitors used would be added to the product water and would meet all applicable state and federal drinking water standards. Corrosion inhibitors are typically phosphorus compounds that are nonhazardous and nontoxic.

The hazardous chemicals would be stored at the plant in tanks designed for the material they would hold, and leaks from or failure of any of the tanks would be contained within the secondary containment provided for all storage tanks (see Chapter 2). Management and response actions would be detailed in a Hazardous Materials Contingency Plan. The plan would identify people on site who would be responsible for taking appropriate action should there be a spill, release, fire, or unexpected chemical reaction involving hazardous materials. Types of responses might involve evacuating buildings, cleaning up the spill, or treating chemicals to minimize adverse effects on human health or the environment. In addition, the Contingency Plan would identify emergency contacts who could provide assistance with injured personnel or containment or treatment of released materials. Except for potential accidents involving the transport of hazardous materials to the site, off-site impacts from spills or releases would not be expected. Spills and releases would be contained within the desalination plant site. No unmanageable risks would be associated with the use of hazardous materials in the operation of the proposed desalination plant.

Hazardous Waste. No hazardous wastes, other than spent solvents and cleaning chemicals, would be generated by the desalination facilities, and these would be generated in small volumes.

Although there are several handlers of hazardous substances and wastes in the region, and some releases have occurred, none were in the immediate vicinity of the proposed site. Fort Bliss is currently managing two IRP sites at Biggs AAF. There is no hazardous waste at either site. There are no IRP sites in the South Training Areas. It is unlikely that ground disturbance and other construction activity would expose the public, workers, or the environment to hazardous substances.

Safety

Ground Safety. Construction and operation of the proposed desalination facilities would be similar to other construction projects and industrial facilities. Standard building and construction procedures and Best Management Practices would be followed by the construction contractor(s). During construction and operation of the desalination plant, all applicable federal and state occupational safety and health requirements would be met.

Implementation of this alternative would involve ground activities that may expose workers building the facility and operating it to some risk. The U.S. Department of Labor, Bureau of Labor Statistics maintains data analyzing fatal and nonfatal occupational injuries based on occupation. Due to the varying range of events classified as nonfatal injuries, the considerations described below focus on fatal injuries, since they are the most catastrophic. Data are categorized as incidence rates per 100,000 workers employed (on an annual average) in a specific industry Standard Industrial Code (SIC).

To assess the relative risk associated with building the proposed facilities, it was assumed that the industrial classifications of workers involved are the Construction Trades (SIC 15, 16, and 17). Based on Department of Labor data and considerations of worker exposure, 11.6 to 15.3 workers per 100,000 employed would be statistically predicted to sustain a fatal injury per year, depending on the specific labor classification. This equates to a probability of a fatal injury of from 1.16 to 1.53 out of 10,000 (U.S.DOL 2003). While the potential result must be considered undesirable, the risk is low. Strict adherence to all applicable occupational safety requirements would further minimize the relatively low risk associated with proposed construction activities.

In considering plant operation, similar statistical data applicable to the public utilities, electric, gas, and sanitary services industries (SIC 49) reflect the statistical probability of 13.6 workers suffering a fatal injury per 100,000 employed per year. This equates to a probability of a fatal injury of 1.36 out of 10,000 (U.S. DOL 2003). This risk projection would be considered "remote." Worker risk associated with operation of the desalination plant would be low.

During operation of the plant, liquid, solid, and hazardous materials would be used, and waste streams would be generated. All material handling and processing would be accomplished in accordance with guidelines established and enforced by TCEQ to ensure compliance with federal and state laws and regulations. Several operations would require permitting. The permitting process ensures that all required safeguards associated with specific actions are implemented, thus minimizing potential human health and safety risks.

Operation of the plant would involve storage and use of up to five chemicals onsite. Anti-scalant and corrosion inhibitor would be stored in fiberglass tanks in an exterior concrete containment compound. Sulfuric acid would be stored in a steel tank in a concrete containment compound. Sodium hypochlorite would also be stored in a closed tank in the same building with sodium hydroxide in a temperature-controlled environment. All chemicals used in the operation of the plant would be piped through a closed system to equipment requiring their use (MC*i*/CDM 2003).

Sulfuric acid would be stored in a 6,000-gallon tank, surrounded by secondary containment walls capable of containing 110 percent of the volume of the tank (6,600 gallons). Acid pumped from the storage area to the injection point would be through dual contained piping (MC*i*/CDM 2003).

Anti-scalant would be stored in a 6,000-gallon tank, with containment walls capable of containing 110 percent of the tank's capacity (6,600 gallons). Transport piping from the storage area to the injection point would be dual contained (MC*i*/CDM 2003).

A 10–15 percent solution of sodium hypochlorite would be stored in a separate, enclosed, environmentally controlled building with the sodium hydroxide solution, just north of the main process building. The sodium hypochlorite tank and sodium hydroxide tank would each hold 10,000 gallons. The building would have a secondary containment structure capable of holding 150 percent of the volume of either tank (MC*i*/CDM 2003).

The infrastructure supporting the handling and use of these materials would meet all applicable safety standards. Minimal risks to human health and safety would be associated with the operation of the plant.

The plant would be protected by a supervised fire alarm system with manual pull stations, combination heat/smoke detectors, and other accessories. Remote annuciators in fire departments would be provided. Buildings would also be equipped with automatic sprinkler systems (MC*i*/CDM 2003).

Plant physical security would involve a multitiered security system. The system would include a perimeter security fence, an entry checkpoint, building intrusion and occupancy monitors, and closed circuit television. Access to the site and individual buildings would be controlled through the use of a coded photo identification badge system (MC*i*/CDM 2003). This would minimize public safety risks associated with the plant.

Flight Safety. The proposed desalination facilities and operations would not affect flight safety at Biggs AAF or EPIA. None of the structures at the site would be tall enough to interfere with departure and arrival flight paths. The site would not be within the Clear Zones or Accident Potential Zones at the end of EPIA runways (see Section 4.7).

4.4.1.2 Disposal of Concentrate

Hazardous Materials and Waste

Hazardous Materials. Construction activities at the proposed deep-well injection site would involve the presence and use of hazardous materials similar to those indicated for the construction of the proposed desalination plant, although less in volume. Similar safety procedures as described above would also be followed for this construction site, minimizing the probability of accidental or inadvertent releases. No hazardous materials have been identified in connection with the deep-well injection site, other than small quantities of household chemicals and solvents.

Hazardous Waste. The deep-well injection site is not expected to generate hazardous waste.

Although there are numerous handlers of hazardous substances and wastes in the region, and some releases have occurred, none are in the immediate vicinity of the deep-well injection site.

Safety

Worker safety considerations associated with the construction and operation of the deep-well injection site would be similar to those described for the construction and operation of the desalination plant.

Military training activities in the vicinity of the injection sites would be conducted in a manner that precludes posing a safety risk to EPWU staff and deep-well injection facilities.

Overall, the construction and operation of the deep-well injection site would create minimal ground safety risks. No flight safety risks would be associated with the deep-well injection facilities.

4.4.2 Alternative 2

The location of the desalination plant would not change the type or amounts of materials used or wastes generated. Safety risks also would not change. Therefore, the impacts of construction and operation of a desalination plant at Site 2 and disposal of the concentrate by deep-well injection would be the same as described for Alternative 1.

4.4.3 Alternative 3

The impacts of construction and operation of a desalination plant at Site 3 and disposal of the concentrate by deep-well injection would be the same as described for Alternative 1.

4.4.4 Alternative 4

4.4.4.1 Desalination Facilities and Operations

The impacts of construction and operation of a desalination plant at Site 1 would be the same as those described for Alternative 1.

4.4.4.2 Disposal of Concentrate

Hazardous Materials and Waste

Hazardous Materials. Construction of the evaporative ponds would involve the presence and use of hazardous materials similar to those indicated for the construction of the proposed desalination plant, although less in volume. Similar safety procedures as described for Alternative 1 would also be followed for this construction site.

Hazardous Waste. Based on studies done of the feed water that would be treated in the proposed desalination plant (and the source of the concentrate components), the residual solids from the evaporation ponds are not anticipated to be hazardous waste (see Table 2-1).

Although there are numerous handlers of hazardous substances and wastes in the region, and some releases have occurred, none are in the immediate vicinity of the FHWRP. No IRP sites are located in the South Training Areas. It is unlikely that ground disturbance and other construction activity would expose persons or the environment to hazardous substances.

Safety

Ground Safety. Ground safety considerations associated with the construction and operation of the evaporation ponds would be similar to those described for the construction and operation of the desalination plant.

Flight Safety. In accordance with FAA Advisory Circular 150/5200-33, *Hazardous Wildlife Attractants On or Near Airports*, the FAA recommends that bird attractants, such as detention or retention ponds, not be located closer than 10,000 feet to any airport, and not encroach closer than 5 statute miles on arrival and departure airspace. The proposed location of the evaporation ponds satisfies this recommendation. Therefore, the evaporation ponds are not expected to increase flight safety risks at Biggs AAF or EPIA.

4.4.5 Alternative 5

The impacts of construction and operation of a desalination plant at Site 2 and disposal of the concentrate using evaporation ponds would be the same as described for Alternative 4.

4.4.6 Alternative 6

The impacts of construction and operation of a desalination plant at Site 3 and disposal of the concentrate using evaporation ponds would be the same as those described for Alternative 1.

4.4.7 No Action Alternative

Under the No Action Alternative, there would be no increase in hazardous materials use and management, hazardous waste generation and management, or safety risks associated with construction and operation of a desalination facility in the South Training Areas of Fort Bliss.

4.4.8 Mitigation Measures

Given the hazardous materials and waste management and safety procedures required by regulation, no additional mitigation measures would be needed.

4.5 AIR QUALITY

For the air quality analysis, the change in air pollutant emissions due to the proposed action and alternatives was estimated and compared to federal and state air quality standards. Criteria to determine the significance of air quality impacts are based on federal, state, and local air pollution standards and regulations. Air quality impacts from a proposed activity or action would be significant if they:

- Increase ambient air pollution concentrations above any NAAQS;
- Contribute to an existing violation of any NAAQS;
- Interfere with or delay timely attainment of NAAQS; or
- Impair visibility within any federally mandated PSD Class I area.

According to the USEPA General Conformity Rule at 40 CFR Part 51, Subpart W, any proposed federal action that has the potential to impact air quality, as described above, in a nonattainment or maintenance area must undergo a conformity analysis. Under this rule, since the City of El Paso is designated as a serious nonattainment area for O_3 and a moderate nonattainment area for CO and PM_{10}, air quality impacts would be potentially significant if project emissions were to exceed one of the thresholds that trigger a conformity analysis (100 tons per year of CO; 100 tons per year of O_3 precursors, VOC and NO_x; and 100 tons per year for PM_{10}). A conformity analysis is not required for pollutants for which a region is designated as attainment.

In attainment areas, PSD rules define a stationary source as "major" if annual emissions exceed 250 tons per year of VOCs, NO_X, CO, SO_X, or PM_{10}. Since the City of El Paso is designated as an attainment area for SO_X, emissions of SO_X would be considered significant if they exceed 250 tons per year. In serious nonattainment areas, New Source Review (NSR) rules define a stationary source as "major" if annual emissions exceed 50 tons of VOCs or NO_X and 100 tons of CO, sulfur oxides (SO_X), or PM_{10}. Project emissions would be potentially significant if they exceed one of these thresholds. This is a conservative approach, as the project includes both stationary and mobile (nonpermitted) emission sources, whereas these thresholds only apply to stationary sources.

Section 169A of the CAA established the PSD regulations to protect the air quality in regions that already meet the NAAQS. Certain national parks, monuments, and wilderness areas have been designated as PSD Class I areas, where appreciable deterioration in air quality is considered significant. The Guadalupe Mountains National Park, the nearest PSD Class I area, is located about 45 miles to the southeast of the project site. Therefore, due to the large distances involved and the very low emission increases from the proposed action (see **Table 4-2**), there would not a significant impact on this PSD Class I area.

4.5.1 Alternative 1

4.5.1.1 Desalination Facilities and Operations

Implementation of Alternative 1 would result in emissions associated with construction and operation of the proposed desalination plant and its supporting infrastructure. Estimated emissions from construction and operation activities under this alternative are provided in Table 4-2. **Appendix G** includes the data and assumptions used to calculate the emissions.

Table 4-2. Estimated Annual Air Pollutant Emissions Under Alternative 1

Source	Emissions (tons per year)				
	CO	SO_2	NO_2	PM_{10}	VOC
Construction Emissions					
Desalination Plant	1.7	0.00	7.7	0.5	0.5
Plant Supporting Infrastructure					
Pipelines and Utility Lines	0.4	0.10	0.9	0.1	0.04
Paved Road and Parking Lot	0.5	0.02	0.5	0.01	0.1
Commuting Vehicles	2.2	0.0006	0.2	0.01	0.3
Total Construction Emissions	**4.7**	**0.1**	**9.3**	**0.7**	**1.0**
Operational Emissions					
Space Heating for Desalination Plant	0.2	0.01	0.2	0.00	0.02
Commuting Vehicles	1.4	0.00	0.1	0.00	0.2
Traffic to Learning Center	1.4	0.2	0.2	0.0006	0.01
Total Operational Emissions	**2.9**	**0.2**	**0.5**	**<0.1**	**0.3**

Note: columns may not total precisely due to rounding.
< less than
CO carbon monoxide
NO_2 nitrogen oxide
PM_{10} particulate matter 10 microns or less
SO_2 sulfur dioxide
VOC volatile organic compounds

Construction Emissions

Construction activities would produce short-term combustion and fugitive dust emissions that cease once construction is completed. Emissions from construction activities include exhaust emissions from heavy equipment (e.g., bulldozers, backhoes) and fugitive dust emissions from demolition and grading activities. In order to present a conservative scenario for analysis, it was assumed that all construction activities would occur over a period of one year, although actual construction is expected to take about 18 months. The actual construction emissions are likely to be less than the estimated emissions (Table 4-2) due to implementation of additional control measures in concert with standard construction practices. For instance, frequent spraying of water on exposed soil during construction is a standard procedure that is used to minimize the amount of dust generated during construction.

Desalination Plant. For analysis purposes, it was assumed that the size of the plant would be 32,000 square feet and would include a process area, an administrative area, a storage building, and the pump stations. Emissions of CO, SO_2, NO_2, PM_{10}, and VOC from construction activities were calculated using emission factors for grading and for general industrial construction (SCAQMD 1993). These emissions include exhaust emissions from on-site construction equipment as well as fugitive dust emissions from grading activities. A summary of the annual emissions from the proposed construction activities at the site is presented in Table 4-2.

Plant Supporting Infrastructure. The plant's supporting infrastructure consists of a 50-vehicle parking lot, a paved road, utility lines, and pipelines. For the purpose of this analysis, it was assumed that the paved road would be a 1,000-foot two-lane road and that the construction of approximately 15 miles of pipelines would be needed for the plant. A summary of the annual emissions from the construction of the proposed supporting infrastructure is presented in Table 4-2.

Vehicular Traffic. For the purpose of this analysis, it was assumed that 25 full-time employees would be working at the project site during the construction of the proposed desalination plant. The resultant increase in commuting emissions due to vehicular travel by construction employees to and from the plant were calculated using emission factors from *Calculation Methods for Criteria Pollutant Emission Inventories* (Jagelski and O'Brien 1994). All commuting vehicles were assumed to be light-duty, gasoline-powered vehicles with 1995 as the average vehicle model year. Annual criteria pollutant emissions from commuting vehicles of 25 full-time employees, assuming an average round-trip commuting distance of 20 miles and a carpooling ratio of 1.1, are shown in Table 4-2.

Operational Emissions

The operation of the proposed desalination plant would generate some direct emissions. These emission sources would include burning of natural gas to provide space heating for the plant. For the purpose of this analysis, it was assumed that plant space heating would annually require approximately 4.4 million cubic feet of natural gas. The resulting emissions are shown in Table 4-2. Although this would be a stationary source, the emissions would be well below any threshold triggering New Source Review.

The operation of the proposed desalination plant would also generate indirect emissions associated with the increased vehicular traffic from plant employees commuting to and from the proposed site and visitors traveling to and from the Learning Center. It was assumed that the operation of the plant would result in the addition of 18 full-time employees working at the proposed site and the addition of 10 cars per day and 2 buses per week that would be visiting the Learning Center. The resultant increases in emissions from vehicular traffic were calculated by assuming an average round trip distance of 20 miles and using emission factors from *Calculation Methods for Criteria Pollutant Emission Inventories* (Jagelski and O'Brien 1994). All commuting vehicles were assumed to be light-duty, gasoline-powered vehicles, while the buses were assumed to be heavy-duty, diesel-powered vehicles, with 1995 as the average vehicle model year. Annual criteria pollutant emissions associated with this transportation are shown in Table 4-2.

Occasional truck traffic would also travel to the desalination plant site to deliver materials and for periodic maintenance. Similarly, there would be occasional trips to the feed and blend wells for inspection and maintenance activities. Air pollutant emissions from these trips were not modeled because they would be incidental and infrequent and would not contribute measurably to air quality impacts.

Clean Air Act Conformity

As shown in Table 4-2, construction and operation of the proposed desalination plant would generate low levels of emissions for CO, NO_2, PM_{10}, and VOC, well below the annual conformity *de minimis* thresholds and the NSR thresholds. Estimated emissions for SO_2 are also well below PSD thresholds and would be insignificant. Therefore, the proposed action would not trigger a conformity determination under Section 176(c) of the CAA, and would not result in long-term impacts on the air quality of El Paso.

4.5.1.2 Disposal of Concentrate

Construction and operation of the deep-well injection facility would generate negligible air pollutant emissions and have no measurable impact on air quality. It is possible that gas or diesel-powered generators would be used at the wells, but insufficient data are currently available about their size and design to model the associated air pollutant emissions.

4.5.2 Alternative 2

The implementation of this alternative would result in the same emissions described under Alternative 1, since construction and operation activities for the proposed desalination plant would be the same.

4.5.3 Alternative 3

The implementation of this alternative would result in the same emissions described under Alternative 1, since construction and operation activities for the proposed desalination plant would be the same.

4.5.4 Alternative 4

Implementation of Alternative 4 would result in emissions associated with construction and operation of the proposed desalination plant and evaporation ponds. Estimated emissions from the construction and operation activities under this alternative are provided in **Table 4-3**. Appendix G includes the data and assumptions used to calculate the emissions.

4.5.4.1 Desalination Facilities and Operations

Estimated emissions from construction and operation of the desalination plant and supporting infrastructure would be the same as described for Alternative 1. The actual construction emissions are likely to be less than the estimated emissions (Table 4-3) due to implementation of additional control measures in concert with standard construction practices. As with Alternatives 1, 2, and 3, this alternative would not trigger a conformity determination under the CAA and would not result in long-term impacts on the air quality of El Paso.

4.5.4.2 Disposal of Concentrate

Construction of the evaporation ponds would require grading of up to 749 acres. For the purpose of this analysis, it was assumed that approximately 257 days would be required to grade the area using a bulldozer, a motor grader and a water truck, based on a 3-acre per day grading rate. A summary of the annual emissions from the construction of the proposed plant and supporting infrastructure is presented in Table 4-3.

Table 4-3. Estimated Annual Air Pollutant Emissions Under Alternative 4

Source	Emissions (tons per year)				
	CO	SO_2	NO_2	PM_{10}	VOC
Construction Emissions					
Desalination Plant	1.7	0.00	7.7	0.5	0.5
Plant Supporting Infrastructure					
Pipelines and Utility Lines	0.4	0.01	0.9	0.1	0.04
Paved Road and Parking Lot	0.5	0.02	0.5	0.04	0.1
Evaporation Ponds	2.9	0.6	6.7	10.4	0.6
Commuting Vehicles	2.6	0.0008	0.3	0.012	0.4
Total Construction Emissions	**8.0**	**0.7**	**16.1**	**11.0**	**1.6**
Operational Emissions					
Space Heating for Desalination Plant	0.2	0.01	0.2	0.00	0.02
Commuting Vehicles	1.6	0.00	0.2	0.00	0.2
Traffic to Learning Center	1.4	0.2	0.2	0.001	0.01
Truck Transport of Evaporated Material	1.5	0.1	1.7	0.2	0.3
Total Operational Emissions	**4.6**	**0.3**	**2.3**	**0.2**	**0.6**

Note: columns may not total precisely due to rounding.
CO carbon monoxide
NO_2 nitrogen oxide
PM_{10} particulate matter 10 microns or less
SO_2 sulfur dioxide
VOC volatile organic compounds

It was assumed that a total of 30 full-time employees would be working at the project site during construction of the proposed desalination plant and evaporation ponds, 5 more than for the construction of the plant and deep-well injection facilities. Emissions from commuting vehicles to and from the project site were calculated based on the same assumptions described under Alternative 1. Annual criteria pollutant emissions from commuting vehicles of 30 full-time employees are shown in Table 4-3.

During operations, it was assumed that a loader would operate 6 hours per day to load the material from the evaporation ponds into a 25-ton capacity truck that would transport the material to the disposal site. A total of 4 truck trips would be required to transport the expected 100 tons of material per day, and a 50-mile round trip distance was assumed. The emissions associated with the loading and transport of evaporated material were calculated using emission factors for heavy-duty vehicles (SCAQMD 1993) and from *Calculation methods for Criteria Pollutant Emission Inventories* (Jagelski and O'Brien 1994). The truck was assumed to be a heavy-duty, diesel-powered vehicle, with 1995 as the average vehicle model year.

Clean Air Act Conformity

As shown in Table 4-3, construction and operation of the proposed desalination plant and evaporation ponds would generate low levels of emissions for CO, NO_2, PM_{10}, and VOC, well below the annual conformity *de minimis* thresholds and the NSR thresholds. Estimated emissions for SO_2 are also well below PSD thresholds and would be insignificant. Therefore, this alternative would not trigger a conformity determination under Section 176(c) of the CAA, and would not result in long-term impacts on the air quality of El Paso.

4.5.5 Alternative 5

The implementation of this alternative would result in the same emissions described under Alternative 4, since construction and operation activities for the proposed desalination plant, supporting infrastructure, and evaporation ponds would be the same.

4.5.6 Alternative 6

The implementation of this alternative would result in the same emissions described under Alternative 4, since construction and operation activities for the proposed desalination plant, supporting infrastructure, and evaporation ponds would be the same.

4.5.7 No Action Alternative

Under the No Action Alternative, the construction of the desalination plant and supporting facilities on Fort Bliss land would not occur. Therefore, no construction emissions and no change in operational emissions would result from this alternative. Other actions may be undertaken by EPWU to increase the supply of potable water and may have similar air quality impacts as the action alternatives described above.

4.5.8 Mitigation Measures

Frequent watering of exposed soil during construction would minimize fugitive dust emissions from construction activities (all action alternatives).

4.6 BIOLOGICAL RESOURCES

The construction and operation of a desalination plant and associated infrastructure could have three types of impacts on biological resources: (1) ground disturbance associated with construction of the desalination plant and concentrate disposal site (Alternatives 1 through 6) that results in loss of native vegetation and habitat for wildlife; (2) risk of soil and groundwater contamination from concentrate disposal (Alternatives 1 through 6) with subsequent impacts on vegetation and wildlife; and (3) risks to wildlife from the concentrate in the evaporation ponds (Alternatives 4 through 6), depending on the level of exposure to sodium chloride, sodium sulfate, and other chemicals such as selenium. Much of the discussion of potential effects focuses on aquatic birds, which readily use evaporation ponds.

The proposed desalination plant is expected to occupy 31 acres at any of the three alternative sites. It is conservatively assumed that the entire area would be disturbed during construction. Construction of the access road, blend wells, and pipelines connecting the feed wells and blend wells to the plant would disturb another 92-103 acres, depending on the alternative. The total area that would be disturbed by construction of the desalination plant (excluding concentrate disposal) would be approximately 122-134 acres.

4.6.1 Alternative 1

4.6.1.1 Desalination Facilities and Operations

Site 1 is located in mesquite coppice dunes and sandscrub habitat, the most widespread vegetation type on Fort Bliss, and one that has been expanding regionally as a result of desertification. There are no arroyos at Site 1.

No sensitive plant is known to occur at Site 1. Sensitive wildlife (particularly the Texas horned lizard) associated with mesquite coppice sand dunes and sandscrub have the potential to occur at Site 1. However, habitat loss due to construction of the plant would not be significant given the widespread distribution of mesquite coppice sand dunes and sandscrub on Fort Bliss and regionally. This is true also for the loggerhead shrike, a bird occupying a wide range of open habitats with patches of trees or shrubs (Dechant et al. 2003), and potentially occurring among mesquite coppice sand dunes in the South Training Areas. The bald eagle is rare in the South Training Areas and not expected to occur at Site 1 due to the lack of open water and tall trees. Construction and operations at the site would not affect this species. All five neotropical migrants detected in mesquite shrublands in the Tularosa Basin (see Section 3.6) are common locally or regionally. Given the small size of the area to be cleared compared to the total area occupied by mesquite coppice dunes regionally, no significant adverse impact on neotropical migrants are expected.

None of the species with the potential to occur at Site 1 are federally listed as threatened or endangered.

4.6.1.2 Disposal of Concentrate

The projected number of deep-well injection sites ranges from three to five. Each site would involve loss of habitat of less than 0.3 acres, for a maximum total of 1.1 acres. The acreage to be disturbed during installation of the concentrate pipeline from desalination plant Site 1 to the proposed deep-well injection site area would be approximately 92 acres. The total area to be disturbed for construction of the deep-well injection facilities under Alternative 1 would be 93 acres or less, about 0.1 percent of the land in the South Training Areas.

The dominant vegetation types at the proposed deep-well injection site are (1) mesquite coppice dunes and sandscrub and (2) creosote bush and tarbush shrublands, both widespread on Fort Bliss (U.S. Army 2000). There are very few arroyos in the South Training Areas. The deep-well injection site includes the terminal end of one arroyo, but injection wells would not be built in or impact the arroyo.

Because the area occupied by the deep-well injection site and the concentrate pipeline is projected to be very small relative to the acreage of open country habitats on Fort Bliss, the proposed project is not expected to have a significant adverse impact on wildlife, including the Texas horned lizard and the loggerhead shrike. Bald eagles are not expected to be affected because of their rarity in the South Training Areas and the lack of open water and tall trees at the injection site. Arroyos are ecologically important to neotropical migrants on Fort Bliss (U.S. Army 2000). However, the proposed project would be located in basin bottom habitat, not in the upland drained by arroyos. Only one arroyo occurs in the project area, and it would be avoided.

Pipelines and utility connections to the injection site would be buried underground along existing roads. Road density would not increase, but road traffic (and in general human disturbance) would increase during the construction phase. Maintenance operations for the deep-well injection sites are expected to be minimal. Catastrophic breaks in the concentrate pipeline could locally affect vegetation.

4.6.2 Alternative 2

4.6.2.1 Desalination Facilities and Operations

Like Site 1, Site 2 is located in mesquite coppice sand dunes and sandbrush habitat. The size of the area to be graded for construction of the plant and pipelines from the blend wells and feed wells would be slightly less than Alternative 1. There are no arroyos at Site 2. Therefore the impact of the desalination plant on biological resources under Alternative 2 would be essentially the same as that described for Alternative 1.

4.6.2.2 Disposal of Concentrate

The concentrate pipeline would be longer than under Alternative 1, resulting in an additional disturbed area of about 12 acres, for a total of approximately 104 acres. Otherwise, potential impacts from disposal of concentrate would be as described for Alternative 1.

4.6.3 Alternative 3

4.6.3.1 Desalination Facilities and Operations

Like Sites 1 and 2, Site 3 is located in mesquite coppice sand dunes and sandbrush habitat and has no arroyos. The size of the area to be graded for construction of the plant would be slightly less than under Alternative 1 or 2. Therefore the impact of the desalination plant on biological resources under Alternative 3 would be similar to that described for Alternative 1.

4.6.3.2 Disposal of Concentrate

Potential impacts from disposal of concentrate would generally be as described for Alternative 1. Approximately 104 acres would be disturbed because of the longer concentrate pipeline required.

4.6.4 Alternative 4

4.6.4.1 Desalination Facilities and Operations

Loss of habitat from construction of the desalination plant and feed and blend well pipelines at Site 1 would be as described under Alternative 1.

4.6.4.2 Disposal of Concentrate

Under this alternative, a total of 12 ponds would be built in an area dominated by mesquite coppice dunes and sandscrub, with small patches of basin grasslands. Construction is estimated to disturb about 749 acres. Mesquite coppice dunes and sandscrub represent the dominant vegetation type on Fort Bliss (U.S. Army 2000). After construction, the size of the evaporation ponds (estimated to be 680.5 acres total) would correspond to less than 1 percent of the mesquite coppice dunes and sandscrub vegetation type in the South Training areas. Among all threatened, endangered, and sensitive plant species documented on Fort Bliss, only the Texas horned lizard and loggerhead shrike have the potential to occur in mesquite coppice dune habitat of the South Training Areas. Both species likely occur among mesquite coppice dunes, but are not restricted to this habitat type.

Basin grasslands are one of several types of grasslands occurring on Fort Bliss (U.S. Army 2000). Grasslands were once presumably more widespread on Fort Bliss, but to a large extent have been converted to mesquite- and creosote-dominated shrublands as part of the ongoing, region-wide desertification (U.S. Army 2000). Relatively large patches of basin grasslands occur in the South Training Areas, but none of them are located at the proposed site for the evaporation ponds. The loss of basin grassland due to the evaporation ponds would be minimal.

Overall, habitat loss from the construction of the evaporation ponds (about 811 acres, including the ponds and concentrate pipeline) would be greater than the loss associated with deep-well injection. At the same time, the evaporation ponds could provide new, valuable stopover habitat for shorebirds, provided that the water they hold is not toxic to them (see below). The fact that the new ponds would be lined, however, decreases their potential value to aquatic birds as a food source.

The proposed evaporation ponds would be built adjacent to the FHWRP and its associated 158 acres of oxidation ponds. The oxidation ponds are unlined and support some vegetation. The proposed evaporation ponds would be lined. Four large ponds comprising a total of approximately 560 acres would be built to receive the concentrate and, although some evaporation would occur in these ponds, eight smaller ponds comprising a total of approximately 160 acres would be allowed to evaporate completely for collection of residual solids.

The salinity and concentrations of various chemicals may or may not form a gradient in the large ponds depending on how the ponds are operated. When the desalination plant first comes on line, the concentrate in the large ponds would have estimated TDS of 6,500 mg/l, (roughly equivalent to a salinity of 6.5 parts per thousand [ppt]) (see Section 4.2.1.2). The estimated levels of arsenic and selenium in the concentrate are 48.5 µg/l and 34.4 µg/l, respectively. The levels of TDS, arsenic, and selenium would increase as the concentrate evaporated in the large ponds. Under steady-state conditions, the salinity in the large ponds is estimated to increase to approximately 24 ppt, somewhat less than the salinity of seawater (35 ppt). The levels of arsenic and selenium in the large ponds are estimated to increase to approximately 180 µg/l and 128 µg/l, respectively Over time, the levels of TDS and chemicals in the feed water are expected to increase, resulting in a proportional increase in their concentrations in the large ponds.

The purpose of the eight small ponds would be to evaporate the concentrate to solids. Therefore, their high salinity and potentially toxic levels of naturally occurring groundwater constituents (e.g., selenium and arsenic) could pose a higher risk of toxicity to wildlife.

Hypersaline waters of evaporation ponds have been linked to a range of adverse effects, including mortality (TCEP 1999, CDFG 2002; USFWS 2003). The salinity of water in the large evaporation ponds, which would comprise 82 percent of the total evaporation pond area, would be less than seawater and considerably less than the salinity (85 ppt) of the southern (lowest salinity) part of the Great Salt Lake (USGS 1999 data). Thus, birds would not be exposed to hypersaline conditions in any of the large ponds. Hypersaline conditions would exist in the small evaporation ponds (covering 160 acres) in which the concentrate would be allowed to evaporate to dryness. The risk of adverse effects from exposure to these hypersaline conditions would be reduced by the presence of much larger areas of lower salinity waters in the large evaporation ponds and freshwater in the nearby oxidation ponds, which together would comprise approximately 718 acres. These conditions are substantially different from conditions in other environments, such as Searles Lake in California (CDFG 2002), where salt toxicosis is a continuing concern. Dissolved selenium can accumulate in aquatic birds (TCEP 1999). Aquatic birds become contaminated when they ingest selenium in food sources. Selenium bioaccumulation can lead to adult mortality, reduced hatching success, or developmental defects (TCEP 1999). Brine shrimp (*Artemia* sp.) occur in brine ponds throughout the world and are readily eaten by aquatic birds (McCrae 1996). A limit of 27 µg/l has been identified to protect aquatic birds from bioaccumulation in brine shrimp in the Great Salt Lake (Brix et al. 2004). While the anticipated concentration of selenium in the large evaporation ponds (up to 128 µg/l) would exceed that limit, the short-term use (a few days) of the evaporation ponds by migrating birds would not likely result in appreciable toxic effects.

Although pretreatment of the feed water would involve adding sulfuric acid, the concentrate would likely have a pH greater than 7 (Trzcinski 2004b), which would not be of concern. An anti-scalant also would be added to the feed water. The chemical constituents of the anti-scalant (phosphoric acid and phosphonic acids) would not add to the potential toxicity of the concentrate.

It might be thought that birds (and other wildlife) would not use high-salinity evaporation ponds, but available evidence indicates otherwise. Birds use the Trona mine evaporation ponds, which hold hypersaline and highly alkaline water and cause bird mortality. The same is true of phosphate fertilizer processing plants, which are associated with highly acidic process water (USFWS 2003). However, Fort Bliss is not situated along a migration corridor, so the evaporation ponds are not likely to attract a large number of birds. Thus, the risks would affect a small, but unknown, number of birds.

Avian botulism represents a threat to birds at evaporation ponds attracting large numbers of aquatic birds (TCEP 1999). Avian botulism occurs in particular where birds concentrate in shallow, warm waters, especially where growth of vegetation supports aquatic invertebrates (Taylor 2004). It is more prevalent in northern Chihuahua than in southern New Mexico and northwestern Texas, and typically follows periods of rainy weather (Taylor 2004). The fact that Fort Bliss is not situated along a major migratory pathway means that the risk of avian botulism at the new evaporation ponds would be reduced. Lining of the ponds would further minimize the risk of avian botulism. Water levels of one foot or less present a higher risk of avian botulism, so it would be desirable that the ponds be operated to have a depth greater than one foot whenever feasible.

The occurrence of avian cholera at evaporation ponds is also possible (TCEP 1999). Type C avian botulism and avian cholera affect at least one-fifth of the estimated 400 species found in or along the shallow, hypersaline Salton Sea in southern California (USBR and Salton Sea Authority 2000). The Salton Sea is much bigger than the proposed evaporation ponds, occupying a 376 square-mile area. Salinity levels in the Salton Sea are much lower than would occur in the evaporation ponds, around 44 ppt. Avian cholera occurs typically as a result of shortage of food, post-migration stress, and cold stress, with a higher risk at locations with high bird densities (Taylor 2004). Avian cholera is seen mostly in snow geese, mallards, and pintails, and is more rare in cranes (Taylor 2004). Although the risk of avian cholera seems low at Fort Bliss because high densities of birds are not expected, monitoring of the ponds should include the immediate removal of dead birds, since the contamination of waters with cholera bacilli would pose a risk of high mortality among birds present.

The possibility exists that some bald eagles present in the El Paso area would be attracted to the evaporation ponds and any concentration of aquatic birds present. That possibility is small, due to the overall rarity of the bald eagle in the area. The absence of tall trees near the evaporation ponds further reduces (but does not eliminate) the likelihood of the species occurring at the evaporation ponds, as bald eagles typically, but not always, select tall trees for perching (Buehler 2000). Consumption of prey with high salt or selenium tissue concentrations could negatively affect bald eagles. Use of evaporation ponds for disposal of the concentrate could affect but is not likely to adversely impact the bald eagle, due to its rarity in the area.

In summary, due to the relatively low density of birds that migrate through this area, compared to the migration corridors along the Rio Grande, significant mortality is not expected.

Solid waste (salt crystals) produced from evaporation at the ponds would be transported to a landfill in the City of El Paso. The large quantity (approximately 100 tpd) of this solid waste to be placed in the landfill, along with the solubility of the salt crystals, presents the possibility of large volumes of salt-contaminated leachate following rainfall. Leachate seeping from the landfill would be captured by the landfill leachate collection system and would not affect vegetation or wildlife.

4.6.5 Alternative 5

4.6.5.1 Desalination Facilities and Operations

The proposed site for the construction of the desalination plant under Alternative 5 (Site 2) is the same as that identified under Alternative 2. Potential impacts to biological resources from desalination facilities and operations would be similar to those discussed under Alternative 1.

4.6.5.2 Disposal of Concentrate

The potential impacts from disposal of concentrate would be the same as described for Alternative 4. About 3 more acres would be disturbed for construction of the concentrate pipeline, due to the greater distance from Site 2 to the evaporation ponds.

4.6.6 Alternative 6

4.6.6.1 Desalination Facilities and Operations

The proposed site for the construction of the desalination plant under Alternative 6 (Site 3) is the same as that identified under Alternative 3. Potential impacts to biological resources from desalination facilities and operations would be similar to those discussed under Alternative 1.

4.6.6.2 Disposal of Concentrate

The potential impacts from disposal of concentrate would be the same as for Alternative 5.

4.6.7 No Action Alternative

The No Action Alternative would not result in any increased impacts on biological resources on Fort Bliss.

4.6.8 Mitigation Measures

Mitigation measures for the action alternatives include:

- Avoidance of any arroyo vegetation, if present, in the placement and installation of injection wells and associated pipelines (Alternatives 1, 2, and 3).
- Maintaining at least a two-foot depth in the FHWRP oxidation ponds during periods of bird migration to minimize the potential for evaporation ponds causing salt toxicosis in birds (Alternatives 4, 5, and 6).
- Monitoring evaporation ponds for dead birds, and removing them as soon as practicable. If high avian mortality occurs, install deterrent systems (e.g., noise-making devices) to keep birds away from areas that are toxic to birds (Alternatives 4, 5, and 6).
- Monitoring chemical concentrations in ponds quarterly, timed with bird migration periods, to develop data for input to screening-level toxicological risk assessments, which should be performed every five years. If the risk assessments indicate the potential for sublethal toxic effects in birds, then deterrent systems should be deployed (Alternatives 4, 5, and 6).

4.7 LAND USE AND AESTHETICS

Land Use

Land use impacts were assessed by determining whether any of the alternatives would displace an existing use or reduce the suitability of an area for its current, designated, or planned use. The alternatives were also assessed to determine compatibility with local plans and regulations (such as zoning) that provide for orderly development to protect the general welfare of the public and with applicable land management objectives of federal and state agencies. Various factors contribute to an assessment of compatibility of a proposed use with current and planned uses. These are generally concerned either with safety or the quality of a desired environment for a particular use. The land use analysis evaluated land use issues during the construction phase and the operational phase of the proposed project.

Aesthetics

The evaluation of impacts to visual resources considered:

- The degree to which the alternatives would alter an existing context or landscape;
- The relative value placed on the affected context or landscape; and
- Accessibility or exposure of viewers to the affected area.

Criteria for assessing impacts from odor include the degree or strength of the odor, and the number of persons affected.

4.7.1 Alternative 1

4.7.1.1 Desalination Facilities and Operations

Land Use

Plant Site 1 would occupy about 31 acres of currently undeveloped land on Fort Bliss. Access would be provided by building a new road from Montana Avenue. The land surrounding Site 1 is used for industrial, aviation, and military training purposes. The industrial character of the proposed facility would be similar in use. Site 1 would provide the greatest separation (about 3.4 miles) from existing residential development on the south side of Montana Avenue.

Plant Site 1 is located within the L_{dn} 65 to 75 decibel (dB) contour for the Biggs/EPIA airfield complex. This noise level is generally compatible with the proposed use. During construction, noise generated at the site would be noticeable in nearby areas, but these areas are either undeveloped or support uses that would not be sensitive to the additional noise. The site is sufficiently removed from sensitive areas (primarily residential areas to the south) that noise would not be a concern. During operations, the facility would contribute very minor noise outside the desalination plant, primarily from the motors that operate the RO pumps and vehicular traffic associated with construction and operations. Resulting noise levels beyond the site boundaries would essentially be the same as existing noise levels.

Site 1 is on the southern edge of training areas used for training missions using tracked vehicles. This location tends not to be used extensively for tracked vehicles because of its proximity to existing developed and active areas (both on post and off). The area is actively used for dismounted training. This training would be generally compatible adjacent to the desalination facility. Fort Bliss has no plans to develop this area with housing or other use that would conflict with the proposed plant.

EPIA has plans to extend its road system and create new connections to Loop 375 and Montana Avenue. These plans are also included in the city's *2025 Master Plan for El Paso*. Conceptual layouts indicate that Site 1 is just north of one possible alignment. This is not expected to constrain future options for this connector and may provide enhanced access to the desalination plant in the future. EPIA is in the process of revising its Master Plan.

The proposed facilities would not be within EPIA runway clear zones or Biggs AAF accident potential zones, so the facilities would be compatible with airport/airfield uses.

During construction, impacts on land use could result from blowing dust from ground disturbing activities. The nearest receptors would be EPIA and Biggs AAF. Blowing dust would not interfere with either the airport or the airfield use assuming dust generation would be limited by dust suppression measures during construction. Also, prevailing winds would tend to blow dust away from the airports.

Public access is permitted in the South Training Areas, and some local residents recreate in the more accessible areas near populated off-post areas. While recreation is not the primary use of Fort Bliss land, the new facility would slightly reduce the area where uses such as jogging, dog walking, and bird hunting could occur. Public recreational access also could pose some security risks for the new facility, but the concerns would be managed with the fencing and security system already designed for the plant. The Learning Center could provide educational and recreational benefits for El Paso residents.

Aesthetics

The land immediately surrounding Site 1 is composed of essentially undeveloped desert lands with mesquite dunes and open, but developed, airfield and airport land. Roads, power lines, and tracks from heavy equipment are evident traces of human use of the surrounding landscape. A combination of strip commercial and industrial development occurs along Montana Avenue, with residential neighborhoods farther south. Given the relatively common landscape characteristics and the degree of constructed modifications in the surrounding landscape, the site location would not be considered to have high scenic value or be sensitive to modification.

The proposed architectural image for the desalination plant (**Figure 4-4**) is one of "simple elegance" (MC*i*/CDM 2002). The facility would include the Learning Center, an administrative area, and the industrial portion of the plant. The components would be arranged around an open courtyard. Durable, functional materials would be used, including split-face concrete block, tile, and glass. The structures would be composed of simple geometric forms. The intent of the design is to be a pleasing expression of functional form.

The facility would be an obvious landmark in the area because it would be dissimilar in architecture to nearby buildings. It also would be an extension of development into an undeveloped landscape. But it would be relatively low in height and hidden from view by intervening terrain and vegetation at fairly close distances (about 1,000 feet). Due to distance and intervening objects, the new desalination facility would not be visible from residential areas. It may be visible as a new feature to travelers along Loop 375, but not out of context with the sporadic structures on Fort Bliss along the highway.

The desalination facility would not produce any odors that would be noticeable outside of the facility.

Figure 4-4. Proposed Architectural Image for the Desalination Plant

4.7.1.2 Disposal of Concentrate

Land Use

The deep-well injection site is located in the northeast part of the Fort Bliss South Training Areas. The surrounding land is undeveloped and is used for military training. Injection activities are expected to be compatible with the military land use.

There may be some existing public use of this part of Fort Bliss for recreational hunting, but the injection wells would not be of sufficient size to limit the area available for hunting. Public access could pose a potential security issue for the injection site, which could be managed through fencing and intruder detection systems.

The Hueco Tanks State Park and historical site is located about 6.7 miles to the southeast of the injection site area (outside the Fort Bliss boundary). It is not expected that the disposal site would affect recreational/educational use of the park.

Aesthetics

The deep-well injection site is in a relatively remote part of the South Training Areas. The extensive mesquite dune landscape is interrupted by occasional hills. To the east of the site, the land rises in a bisected escarpment. Unpaved roads cross the landscape in widely spaced and irregular patterns, with additional linear imprinting from track-wheel vehicle trails and fences. The deep-well injection facilities would be of the size and have the general appearance of an electrical or gas field substation, composed of some concrete pads with equipment, storage tanks, and mechanical apparatus.

In this context, the injection facilities would be relatively indistinct in the open landscape except at close distances (1,000 feet). In a mesquite dune landscape, a viewer's field of vision is restricted by the dunes themselves when traveling overland either in a vehicle or on foot; each dune and mesquite shrub rises about 8 feet from the surrounding ground plain. From surrounding areas that are slightly higher, the facility may be noticeable, but not unlike other isolated structures (ranging from single buildings to complexes of facilities) found throughout the installation training areas. The surrounding natural context is relatively common and widespread. Most viewers would be employees working on Fort Bliss. The public may use this area infrequently for bird hunting and solitary recreation, but, overall, relatively few people would be exposed to the injection facilities.

The Hueco Tanks State Park and historic site is sensitive to changes in the landscape from a historic context. However, it is unlikely that the injection facilities would be visible from the park, so they should not affect viewing experiences at the park.

Construction of the concentrate pipelines would require clearing of vegetation and trenching. Soil would be redeposited in the trenches and graded to the surrounding ground level. The pipelines to the deep-well injection site would generally use existing utility and road easements. Pipeline corridors introduce linear traces into the landscape, but these would be less noticeable if placed within an existing corridor and therefore not introduce a new linear feature into the visual environment. If the pipeline were aligned outside an existing roadbed, newly disturbed vegetation would recover over time, but it might be somewhat different from the characteristic dunes and mesquite landscape, leaving visible traces of disturbance.

No odors are expected to emanate from the deep-well injection facilities.

4.7.2 Alternative 2

4.7.2.1 Desalination Facilities and Operations

Land Use

Plant Site 2 is located immediately east of EPIA, west of Loop 375. It is about a mile south of Site 1. Access to Site 2 would be provided by a new access road built from Montana Avenue. Impacts on land use from constructing a desalination facility in this location would be similar to those described for Alternative 1. This section focuses on differences in impacts on land use from this site compared to Site 1.

EPIA indicated in discussions with EPWU that the airport's Master Plan identifies the Site 2 area as a "Potential Area for Joint Industrial Park" (MC*i*/CDM 2003). Using this site for the proposed desalination plant may require EPIA to modify its future development plans but should not significantly affect expansion options. EPIA is in the process of revising its Master Plan.

Site 2 is outside the L_{dn} 65 dB contour for the Biggs-EPIA airfield complex. The proposed use would be compatible with noise levels from airfield operations. During construction, noise at this site could be more noticeable than at Site 1, although there are few sensitive receptors near the site. During operation, noise levels would be slightly more noticeable close to this site than at Site 1 because existing noise levels are lower, but noise from the plant is anticipated to be essentially unnoticeable within one to two hundred feet of the facility.

This site is separated from residential areas by distance, other development, and major roadways, so there would be no impact on residential use. The site does not appear to conflict with conceptual layouts for future roadways; however, future options could be influenced by the placement of the plant in this location.

Aesthetics

Under this alternative the desalination plant Site 2 would be about a mile south of Site 1. Impacts from developing the plant on this site would be similar to those described for Alternative 1.

4.7.2.2 Disposal of Concentrate

Impacts on land use and aesthetics from the deep-well injection site would be the same as described under Alternative 1.

4.7.3 Alternative 3

4.7.3.1 Desalination Facilities and Operations

Land Use

Plant Site 3 is located immediately east of EPIA, about half a mile north of Montana Avenue. The access road would be built off Montana Avenue. Impacts on land use from building a desalination facility in this location would be similar to those described for Alternative 1. This section focuses on differences in impacts on land use from this site compared to Site 1.

This site is close to existing commercial and residential development along Montana Avenue. However, it is located sufficiently far from the roadway and land uses along the avenue that there would be little functional or visual interaction with the surrounding land uses.

The El Paso Master Plan delineates the Montana Avenue corridor, excluding Fort Bliss land, for mixed commercial use. EPIA has considered land close to Montana Avenue for future development. Construction of a desalination facility in this location may require EPIA to modify its future development plans but should not significantly affect expansion options. As noted above, EPIA is in the process of revising its Master Plan.

Security at the desalination plant would provide adequate separation between this proposed industrial use and any future commercial development. Like Plant Site 1, this location may conflict with conceptual alignments for new roadways from Loop 375 serving the airport. Alternative roadway alignments would need to be coordinated to ensure that the planning and design of the roadway is compatible with plant development.

Because of the proximity of the site to developed areas, impacts on existing land uses may occur during the construction phase. Noise from equipment and vehicles and blowing dust may have some temporary impact. Blowing dust would be minimized through use of dust suppression techniques during construction. Noise at the construction site would not be audible at Montana Avenue, partially due to the elevated vehicle noise levels that exist along that busy route. Increased localized noise would be temporary and unlikely to affect land use in the area. During operation, noise generated by the facility would be imperceptible in this area.

Aesthetics

Impacts from developing the proposed desalination plant on Site 3 would be similar to those described for Alternative 1. Site 3 would be closer to other developed areas along Montana Avenue, making it closer to (and similar to) the existing developed context. The site is located about 0.5 miles from the closest homes, with Montana Avenue and natural vegetation in between dominating the view. Developing Site 3 is expected to have little impact on aesthetics.

4.7.3.2 Disposal of Concentrate

Impacts on land use from the deep-well injection site would be the same as described under Alternative 1.

4.7.4 Alternative 4

4.7.4.1 Desalination Facilities and Operations

Impacts to land use and aesthetics from building and operating a desalination plant at Site 1 would be the same as described for Alternative 1.

4.7.4.2 Disposal of Concentrate

Land Use

The evaporation ponds would be located adjacent to the FHWRP east of US 54. This location was selected considering the existing use and real estate status of the adjacent water reclamation facility. From a land use perspective, the existing use and the evaporation ponds would be compatible with each other. Surrounding land on Fort Bliss is essentially undeveloped and used for military training. This parcel would represent less than 1 percent of the South Training Areas. This would be a relatively minor commitment of land overall.

Construction of the evaporation ponds would likely extend over an 18-month period. Because of the extensive area to be excavated (about one square mile), there could be considerable blowing dust until the pond liners are in place. This would be controllable through dust suppression techniques during construction, and would be a temporary impact. Prevailing winds from the south and west would tend to blow dust away from populated areas and highways, limiting potential impacts on other land uses. Easterly winds are more prevalent in late summer and early fall, and appropriate dust suppression techniques would be more important during this time of year.

Noise during construction (and operation) would not be a concern because of the distance of the site from off-post areas. Construction noise would dissipate to background levels beyond the Fort Bliss boundary, 0.3 mile away.

Aesthetics

The evaporation ponds would be developed as a series of contiguous ponds covering an area of over one square mile. A 3-foot high embankment would surround each pond. The layout would have the appearance of a large grid.

The new facility would be on the eastern boundary of the existing FHWRP. The existing facility has a cluster of buildings and about 158 acres of oxidation ponds. The evaporation ponds would be an extension of this feature and would be a major imprint on the landscape.

The evaporation pond site has low scenic value, being flat and undistinguished in form and vegetation. Existing modifications in the landscape include the oxidation ponds, US 54, a railroad corridor, intermittent industrial facilities along Railroad Road and Dyer Street, and a mobile home community about 0.75 mile west of the site.

Off-post land on the west side of US 54 is a mixture of undeveloped land and new suburban development. The evaporation ponds would not be directly visible from most locations due to distance, intervening terrain, and vegetation. But closer to the Franklin Mountains, as viewers gain elevation, the evaporation ponds would be a large visible feature in the landscape. Because most suburbs create an internal viewscape, the ponds would not directly affect the ambiance of many residential areas, but they would likely be visible to homes with views over the valley.

At close (under 1,000 feet) viewing distances, the ponds would completely dominate the viewscape. To the west, as the valley elevation rises, the ponds would be very noticeable in the middle distance. For viewers traveling along US 54, the new feature would be similar to the already highly altered context of the area. Farther west, terrain rises steeply in the Franklin Mountains. Viewers at high elevations would notice the evaporation ponds due to their size and the contrast of their surface (either water or light colored salt deposits) with the pattern of the desert floor vegetation. Although the scenic value of the Franklin Mountains Wilderness Area is protected, viewshed protection does not extend to the valley floor.

There is a possibility that odor could be produced by chemicals in the evaporation ponds. Strong odors would only be a concern if the ponds became anaerobic, which is unlikely. Otherwise, the odor would be similar to that experienced at salt lakes and less noticeable than existing odors from the oxidation ponds and a nearby food processing plant. The odors would be stronger and drift farther under low wind conditions than under high wind conditions. For the most part, prevailing winds would convey odors away from off-post areas. However, with winds from an easterly direction, residents in a small mobile home community on the west side of US 54 about 0.75 mile from the proposed evaporation ponds could be exposed to any odors produced.

4.7.5 Alternative 5

4.7.5.1 Desalination Facilities and Operations

Impacts on land use and aesthetics from building and operating a desalination plant on Site 2 would be the same as described for Alternative 2.

4.7.5.2 Disposal of Concentrate

Impacts to land use and aesthetics from developing evaporation ponds for the disposal of concentrate would be the same as described for Alternative 4.

4.7.6 Alternative 6

4.7.6.1 Desalination Facilities and Operations

Impacts on land use and aesthetics from building and operating a desalination plant on Site 3 would be the same as described for Alternative 3.

4.7.6.2 Disposal of Concentrate

Impacts on land use and aesthetics from developing evaporation ponds for the disposal of concentrate would be the same as described for Alternative 4.

4.7.7 No Action Alternative

Under the No Action Alternative, there would be no change in the land use or aesthetics of the South Training Areas due to the proposed desalination project.

4.7.8 Mitigation Measures

No mitigation measures are identified for land use or aesthetics.

4.8 TRANSPORTATION

The primary measure of impact on ground transportation from implementing the alternatives is the effect of project activities on traffic flow. Factors considered include existing traffic flow conditions (or level of service, as described in Section 3.8), the relative increase in trips on selected roadway segment, ingress and egress from project sites onto the public road network, and the compatibility of project-related trips and vehicles with existing timing and mix of vehicular use on key roadways. Also considered is the compatibility of proposed sites with plans for constructing new roadways.

This assessment is based on the following general average-day assumptions about project-generated trips:

- During the construction phase, there would be up to 25 round trips per day to the desalination plant site, and about 5 round trips per day to the concentrate disposal site. There would be a mixture of privately owned vehicles (POVs) and contractor or city-owned light and heavy trucks.
- During the operational phase, project-related traffic is projected to include:
  - about 16 commuting round trips per day to the desalination plant site (mostly in POVs);
  - one or two hazardous materials (sulfuric acid, sodium hydroxide, sodium hypochlorite, Pretreat Plus™ Y2K) deliveries per week;
  - about ten round trips per day in POVs and two buses per week visiting the Learning Center; and
  - under Alternatives 4, 5, and 6, four round trips per day by heavy trucks hauling residual solids from the evaporation ponds to the McCombs landfill and two commuting trips per day in POVs to the evaporation pond facility.

It is also assumed that access to the desalination plant would be off Montana Avenue to all three sites. The terminus at Montana Avenue would be a three-way (T-junction) intersection without a signal.

4.8.1 Alternative 1

4.8.1.1 Desalination Facilities and Operations

The exact alignment of the desalination plant access road has not yet been determined, but it could parallel the boundary between Fort Bliss and EPIA, intersecting with Montana Avenue at some point between the EPIA eastern boundary and Lee Trevino Drive. Roadway projects planned by the MTP for an Inner Loop between Biggs AAF and EPIA are shown as overlapping with the access road to the site. Placement of the access road could either influence future alignments for the Inner Loop, require special bridges or tunnels to maintain separation of these routes, or necessitate reconstruction of the access road in the future to link to the new loop road. Planning for the access road would need to be coordinated with city and state transportation engineers to provide access in a manner that preserves flexibility for planned projects and future development of this area.

Trips to and from the desalination plant are estimated to be slightly higher during the construction phase than the operational phases, with a slightly higher mix of trucks during construction. POV trips would tend to coincide mostly with peak hour traffic, particularly during the operational phase. The number of trips that might be generated by visitors to the Learning Center is not known. For analysis purposes, it was assumed there would be about 10 cars per day and two buses per week to the center.

The estimated 25 daily round trips (50 one-way trips) during construction and 16 daily round trips during operations would be added to traffic loads on Montana Avenue. Although this number of trips represents an extremely small increase over current levels (less than 0.15 percent), this segment of Montana Avenue is already functioning at 38 percent above acceptable volume/capacity (LOS C) (see Table 3-13). The project-related peak hour traffic would increase traffic volume to 39 percent above acceptable volume/capacity. The additional traffic load, although small, would exacerbate existing congestion on Montana Avenue. Placement and design of the new access road to the desalination facility relative to existing intersections would need to be carefully planned to provide a safe interchange with minimum interruption of Montana Avenue traffic flow.

Some portion of the trips to the desalination plant may use other roadways in the local area en route to the site, many of which are also congested at peak hours. Loop 375, which is currently operating well below its design capacity, would be unaffected.

One or two truckloads of hazardous materials would be transported to the plant site using Loop 375 to Montana Avenue and then traveling a short distance east on Montana Avenue to the plant access road. Loop 375 is a Hazardous Cargo road designated for transport of hazardous materials. The number of current hazardous cargo trips on this route is unknown. But given the relatively low traffic volume on this road, it is not is expected that project-related truck traffic would appreciably increase the risk of accidents along this route. If an accident occurred, existing response procedures are in place to handle any associated release of hazardous materials.

Montana Avenue is not a hazardous cargo route. Given the existing congestion on Montana Avenue and the limited number of deliveries projected, there would be a small increased risk of accidents with these deliveries. Accidents involving vehicles carrying hazardous cargo typically release small (a few gallons or less) volumes of hazardous materials (USDOT Summary Statistics and Data; http://hazmat.dot.gov/ohmforms.htm#summaries) as a result of accidents, and effects on nearby residences and commercial establishments would likely be temporary and minor should an accident occur.

The area immediately surrounding Site 1 is undeveloped, which decreases the risk of adverse impacts from a release at the site itself (e.g., during off-loading). It is not expected that the delivery of hazardous materials to the desalination plant would appreciably increase risks to aviation at EPIA.

4.8.1.2 Disposal of Concentrate

Trips to the deep-well injection site would use roads in the South Training Areas. During operations, the few trips projected to the site (on the order of one per week) would not affect the range road network. Range roads have relatively low numbers of trips and free-flowing traffic, so the added trips would not interrupt the flow of traffic. Mission activities may occasionally cause unexpected delays, closures, or slow traffic along range roads. EPWU would need to need to coordinate routine trips with Fort Bliss to preclude conflicts with military training. In addition, EPWU and Fort Bliss would need to develop a procedure for providing timely access to the concentrate pipeline route in the event of a leak, so that the damaged pipeline segment can be isolated and repaired.

4.8.2 Alternative 2

4.8.2.1 Desalination Facilities and Operations

Impacts on transportation if a desalination plant were built and operated on Site 2 would be the same as those described for Alternative 1.

4.8.2.2 Disposal of Concentrate

Impacts on transportation from constructing and operating a deep-well injection site would be the same as those described for Alternative 1.

4.8.3 Alternative 3

4.8.3.1 Desalination Facilities and Operations

Impacts on transportation if a desalination plant were built and operated on Site 2 would be the same as those described for Alternative 1.

4.8.3.2 Disposal of Concentrate

Impacts on transportation from developing and operating the deep-well injection site would be the same as those described for Alternative 1.

4.8.4 Alternative 4

4.8.4.1 Desalination Facilities and Operations

Impacts on transportation from building and operating a desalination plant at Site 1 would be as described for Alternative 1.

4.8.4.2 Disposal of Concentrate

Construction of the evaporation ponds is estimated to involve about 5 trips daily (on average) to the site during construction. Initially, heavy equipment would be transported to the site. Most trips thereafter would be POVs of the construction workers. During the operational phase, there would be an estimated two round trips a day by workers and about four round trips a day (on average) by heavy trucks hauling the residual solids to the McCombs landfill. Most traffic would be likely to use Dyer Street (Business US 54A) or Railroad Road en route to the site. The small projected number of trips distributed on those roads would contribute negligible change in traffic flow. Traffic conditions along the route between the evaporation ponds and the McCombs landfill is not known, but the estimated number of truck trips transporting residual solids to the landfill would not measurably affect traffic flow.

4.8.5 Alternative 5

4.8.5.1 Desalination Facilities and Operations

Impacts on transportation from building and operating a desalination plant at Site 2 would be the same as described for Site 1 in Alternative 1.

4.8.5.2 Disposal of Concentrate

Impacts on transportation from construction and operation of the evaporation ponds would be the same as described for Alternative 4.

4.8.6 Alternative 6

4.8.6.1 Desalination Facilities and Operations

Impacts on transportation from building and operating a desalination plant at Site 3 would be the same as described for Site 3 in Alternative 3.

4.8.6.2 Disposal of Concentrate

Impacts on transportation from construction and operation of the evaporation ponds would be the same as described in Alternative 4.

4.8.7 No Action Alternative

Under the No Action Alternative, transportation conditions would not change due to construction and operation of a desalination facility and associated infrastructure on Fort Bliss land.

4.8.8 Mitigation Measures

Mitigation measures for the action alternatives include:

- Design of the entry and exit from the desalination plant to Montana Avenue to minimize impact on traffic flow (all action alternatives).
- Coordination between EPWU and Fort Bliss to provide access to the deep-well injection facilities without conflicting with military training in the Training Areas where the facilities would be located (Alternatives 1, 2, and 3). Development of procedures to allow EPWU emergency access to the concentrate pipelines in the event of a leak or failure, in order to isolate and repair the affected pipeline segment (all action alternatives).

4.9 CULTURAL RESOURCES

A number of federal regulations and guidelines have been established for the management of cultural resources. Section 106 of the National Historic Preservation Act (NHPA) as amended, requires federal agencies to take into account the effects of their undertakings on historic properties. Historic properties are cultural resources that are listed in, or eligible for listing in, the NRHP. Eligibility evaluation is the process by which resources are assessed relative to NRHP significance criteria for scientific or historic research, for the general public, and for traditional cultural groups. Under federal law, impacts to cultural resources may be considered adverse if the resources have been determined eligible for listing in the NRHP or have been identified as important to Native Americans as outlined in the American Indian Religious Freedom Act and Executive Order 13007 Indian Sacred Sites.

The *Native American Graves Protection and Repatriation Act (NAGPRA)* (1990) describes the rights of Native American lineal descendants, Indian tribes, and Native Hawaiian organizations with regard to human remains, funerary objects, sacred objects, and objects of cultural patrimony with which they can demonstrate lineal descent or cultural affiliation. NAGPRA affirms the right of these individuals or groups to decide disposition or take possession of such items. A tribe having cultural affiliation may request repatriation of human remains and funerary objects. NAGPRA also protects Native American burial sites and controls the removal of human remains, funerary objects, sacred objects, and items of cultural patrimony on federal and tribal lands.

DOD's *American Indian and Alaska Native Policy* (1999) provides guidance for interacting and working with federally recognized American Indian governments. DOD policy requires that military installations provide timely notice to, and consult with, tribal governments prior to taking any action that may have the potential to significantly affect protected tribal resources, tribal rights, or American Indian lands.

The analysis of potential impacts to cultural resources considers direct impacts that may occur by physically altering, damaging, or destroying all or part of a resource; altering characteristics of the surrounding environment that contribute to the resource's significance; introducing visual or audible elements that are out of character with the property or alter its setting; or neglecting the resource to the extent that it deteriorates or is destroyed. Direct impacts were assessed by identifying the types and locations of proposed activity and determining the cultural resources that could be affected. Indirect impacts generally result from increased use of an area containing significant cultural resources.

4.9.1 Alternative 1

4.9.1.1 Desalination Facilities and Operations

Construction and operation of the desalination facilities under Alternative 1 are not expected to impact identified cultural resources. Although archaeological survey of the South Training Areas (Whalen 1978) located many archaeological sites, the Plant Site 1 location was selected to avoid any known sites (Barrera 2003). Traditional resources have not been identified within the project area.

The proposed blend wells would be located along the Loop 375 corridor where undisturbed archaeological resources are unlikely. The exact siting of these wells would either avoid archaeological sites or mitigate any effects to NRHP-eligible sites in consultation with the Texas Historical Commission. Similarly, construction of the pipelines from the feed and blend wells to the desalination plant would avoid archaeological sites where practicable. Where avoidance is not practicable, effects to NRHP-eligible archaeological sites would be mitigated in consultation with the Texas Historical Commission (THC).

In the event of unanticipated discoveries of cultural resources during ground disturbing activities, work would halt and the resources would be managed in compliance with federal law and Army regulation. The Fort Bliss Integrated Cultural Resource Management Plan (ICRMP) specifies procedures for handling unanticipated discoveries of cultural resources.

Facility operations would not entail additional ground-disturbing activity outside areas previously disturbed for construction. Employees and visitors to the fenced site would be restricted to the facility and would not have access to the surrounding area. It is expected that there would be no cultural resources management requirement for the plant site (fenced area) itself. Cultural resources in the surrounding area would continue to be managed by the Army in compliance with federal law and Army regulation.

4.9.1.2 Disposal of Concentrate

Because of the large number of archaeological sites in the project area, construction of the deep-well injection facility and associated pipelines has the potential to impact sites associated with Native American use of the western Hueco Bolson. Project planning would avoid these sites where practicable. Where avoidance is not practicable, effects to NRHP-eligible archaeological sites would be mitigated in consultation with THC and interested tribal governments. Compliance with Section 106 of the NHPA, including NRHP evaluation of previously recorded sites along the pipeline route, would take place prior to construction. Fort Bliss has initiated contact with the THC regarding the proposed action and alternatives.

Deep-well injection operations would not entail additional ground-disturbing activity outside areas previously disturbed for construction. Cultural resources in the vicinity would continue to be managed by the Army in compliance with federal law and Army regulation. EPWU employees accessing the injection facilities would be expected to comply with federal regulations prohibiting collection of or damage to cultural resources in the South Training Areas.

Although no traditional resources have been identified within the project area, some potential concerns have been raised by Native American groups regarding the deep-well injection site (Barrera 2003). Fort Bliss has initiated contact with the Mescalero Apache Tribe and the Tigua Tribal Government to identify potential concerns regarding the proposed action and alternatives.

4.9.2 Alternative 2

4.9.2.1 Desalination Facilities and Operations

Construction of the desalination facilities under Alternative 2 is not expected to impact identified cultural resources. Like Site 1, the plant Site 2 location was selected to avoid any known archaeological sites (Barrera 2003). Traditional resources have not been identified within the project area. In the event of unanticipated discoveries of cultural resources during construction of the plant, blend wells, and feed and blend well pipelines, work would halt and the resources would be managed in compliance with federal law, Army regulation, and the Fort Bliss ICRMP.

Employees and visitors to the fenced site would be restricted to the facility and would not have access to the surrounding area. It is expected that there would be no cultural resources management requirement for the plant site (fenced area) itself. Cultural resources in the surrounding area would continue to be managed by the Army in compliance with federal law and Army regulation.

4.9.2.2 Disposal of Concentrate

Impacts on cultural resources from deep-well injection of the concentrate would be the same as described for Alternative 1.

4.9.3 Alternative 3

4.9.3.1 Desalination Facilities and Operations

Construction of the desalination facility under Alternative 3 is not expected to impact identified cultural resources. The plant Site 3 location was selected to avoid any known archaeological sites (Barrera 2003). Traditional resources have not been identified within the project area. In the event of unanticipated discoveries of cultural resources during construction of the plant, blend wells, and feed and blend well pipelines, work would halt and the resources would be managed in compliance with federal law, Army regulation, and the Fort Bliss ICRMP.

Employees and visitors to the fenced site would be restricted to the facility and would not have access to the surrounding area. It is expected that there would be no cultural resources management requirement for the plant site (fenced area) itself. Cultural resources in the surrounding area would continue to be managed by the Army in compliance with federal law and Army regulation.

4.9.3.2 Disposal of Concentrate

Impacts on cultural resources from deep-well injection of the concentrate would be the same as described for Alternative 1.

4.9.4 Alternative 4

4.9.4.1 Desalination Facilities and Operations

Potential impacts to cultural resources from desalination facility construction and operations would be the same as described for Alternative 1.

4.9.4.2 Disposal of Concentrate

Construction and operation of the evaporative ponds under Alternative 4 could impact cultural resources. The proposed evaporation ponds would be located in an area that contains approximately 20 known archaeological sites associated with Native American use of the western Hueco Bolson that were surveyed in 1968 (Barerra 2004). Prior to construction, each of these sites would need to be evaluated for NHRP eligibility. The evaluation would require on-the-ground determination of the contents of each of the sites through shovel testing and other exploratory techniques. Should any of the sites be NRHP eligible, impacts would be mitigated in consultation with the THC and interested tribal governments prior to any ground-disturbing activities.

Because of the large number of archaeological sites in the project vicinity, construction of the pipeline from the desalination plant site to the evaporation ponds has the potential to impact sites. Project planning would avoid these sites where possible. Where avoidance is not possible, effects to NRHP-eligible archaeological sites would be mitigated. Compliance with Section 106 of the NHPA, including NRHP evaluation of previously recorded sites along the pipeline route, would take place prior to construction.

In the event of unanticipated discoveries of cultural resources during ground disturbing activities at either the pond site or along the pipeline, work would halt and the resources would be managed in compliance with federal law, Army regulation, and the Fort Bliss ICRMP.

4.9.5 Alternative 5

4.9.5.1 Desalination Facilities and Operations

Potential impacts to cultural resources from desalination facility construction and operations would be the same as described for Alternative 2.

4.9.5.2 Disposal of Concentrate

Potential impacts to cultural resources from construction and operation of evaporative ponds and associated pipeline would be the same as described for Alternative 4.

4.9.6 Alternative 6

4.9.6.1 Desalination Facilities and Operations

Potential impacts to cultural resources from desalination facility construction and operations would be the same as described for Alternative 3.

4.9.6.2 Disposal of Concentrate

Potential impacts to cultural resources from construction and operation of evaporative ponds would be the same as described for Alternative 4.

4.9.7 No Action Alternative

Under the No Action Alternative, no impacts to cultural resources would be caused by construction of a desalination plant and associated facilities on Fort Bliss land. Cultural resources on Fort Bliss would continue to be managed by the Army in compliance with federal law, Army regulation, and the ICRMP.

4.9.8 Mitigation Measures

Compliance with applicable laws and regulations would provide adequate protection for cultural resources on Fort Bliss lands affected by the proposed action. This would include mitigating adverse effects to NRHP-eligible archaeological site in consultation with the THC and interested tribal governments when avoidance of archaeological sites or artifacts is not practicable. An archaeologist would be required to be on site during any ground disturbing activities on Fort Bliss land. No additional mitigation measures have been identified for cultural resources.

4.10 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

The analysis of socioeconomic impacts and environmental justice concerns considers the following:

- Effects on jobs and earnings;
- Potential effects on water rates and cost of living for El Paso residents;
- Potential for growth inducement; and
- Disproportionately high and adverse effects on minority and low-income populations.

The following assumed values have been used in the analysis:

- The public investment in developing the desalination plant would be about $72 to $91 million, depending on the disposal method selected (disposal by evaporation ponds and landfilling would have the higher cost).
- Construction would take place over 18 months. Construction would generate about 25 full-time jobs to develop the desalination plant and deep-well injection site. Construction would generate about 30 full-time jobs to develop the desalination plant and evaporation ponds.
- Operating the desalination plant and deep-well injection site would support about 16 jobs.
- The total cost for service improvements for El Paso water infrastructure projects through 2022 is $41.44 million (EPWU 2003c), not including the costs for new water treatment plants. EPWU projects that as much as $500 million will be spent in the coming decade to import water from counties east of El Paso.

4.10.1 Alternative 1

4.10.1.1 Desalination Facilities and Operations

Socioeconomics

Employment and Earnings. The proposed project is estimated to support an additional 16 operational jobs in El Paso County. This increase would be negligible (less than 0.01 percent), as would the impact of these jobs on the projected 16.5 percent job growth rate over the next decade. Similarly, the change in total personal income for the county from additional jobs would also be extremely small, although any increase is considered beneficial for the local economy. The capital spent on services and goods for the project would provide some additional benefit to the local economy, although many of the procurements for equipment and materials would likely be from outside the local area.

Water Rates. EPWU has projected that water rates will increase over current costs. A 19 percent rate increase is projected in 2004 to support planned expenditures for water and wastewater projects and provision for water (including importing water)(Crowder 2004). The new water rates would place El Paso between Dallas and Denver based on their 2002 water rates (see Table 3-20), assuming no changes in their rates. Assuming that utilities represent 8 percent of household costs (as a nation-wide average) (Sperling 2004), applying a 19 percent increase to this category of living expenses would increase the cost of living in El Paso by less than 2 percent, from 94.3 percent to about 96 percent of the national average. This overestimates the possible impact on cost of living because water is only a portion of a household's utility expenses.

Population Growth. The small number of jobs associated with the proposed project would not stimulate any measurable immigration of population into the county or have a direct effect on population. The potential for the proposed project to augment the El Paso water supply and thereby indirectly stimulate growth is not determinable. While the lack of water may curtail growth, adequate water supply is only one of many factors that account for growth in an area. In developed countries, including the U.S., growth responds to combinations of factors ranging from desirable climate, crime rate, education system, air quality, job opportunities, cost of living, and recreational and cultural amenities. The desalination project is being developed to extend the life of the Hueco Bolson Aquifer, not to increase water supply. In combination with other planned improvements, it can be expected to increase water supply in the long term.

Environmental Justice

The analysis in this EIS has not identified any significant environmental or human health impacts that may directly or indirectly affect people or their activities. Section 3.10 identifies census tracts with higher than county average proportions of minority or low-income populations in the area of potential effect. These tracts would not be affected by disproportionately high and adverse impacts from the proposed action.

Some concern was expressed during scoping that the proposed use of brackish water from the Hueco Bolson could increase withdrawals and adversely affect private wells that draw from the aquifer. EPWU has indicated that withdrawals from existing wells would be reduced when the new blend wells are installed, so the total amount of water taken from the aquifer would be the same, only from brackish rather than freshwater supplies. This would have the effect of preserving the freshwater supplies and could ultimately benefit private and other wells in the region. Pumping from the feed wells and blend wells would increase groundwater drawdown in the immediate vicinity of those wells, but the effect would diminish with distance from the wells. Offsetting decreases in pumping from EPWU wells west and north of the project area would result in reduced drawdown in those areas. Overall, there are no known adverse impacts on other wells in the region, and no disproportionately high and adverse impacts on minority or low-income populations have been identified.

Montana Avenue, which is a major route between the City of El Paso and areas south and east of Fort Bliss, is currently operating 38 percent over capacity. Census tracts south and east of Fort Bliss contain higher than county average proportions of minority and low-income populations. Since access to the proposed desalination plant site would be from Montana Avenue, project-related traffic would increase the number of peak-hour trips on Montana Avenue, so that it would operate at 39 percent over capacity (one percent change). Although minority and low-income populations may be more affected by this change, it would not be a disproportionately high and adverse impact.

The cost to EPWU water customers is projected to increase whether or not the proposed desalination facility is built. Use of alternate sources of potable water is likely to increase as currently available sources become less suitable for drinking water. The cost of the proposed project would be small in comparison to the $50 million per year EPWU plans to spend over the next 10 years to import potable water. While the increased cost of water would have a greater impact on low-income persons than the general population, the increased cost would not be caused by the proposed project because if the project is not implemented, alternative sources of potable water will need to be found.

4.10.1.2 Disposal of Concentrate

Deep-well injection of the concentrate is not expected to have any socioeconomic impact or to create disproportionately high and adverse impacts on minority or low-income populations. The Colonias south of the proposed injection site are not expected to be affected by injection operations.

4.10.2 Alternative 2

Socioeconomics

Socioeconomic impacts from this alternative would be the same as described for Alternative 1.

Environmental Justice

As was described for Alternative 1, this alternative is not expected to generate disproportionately high and adverse impacts on minority or low-income populations.

4.10.3 Alternative 3

Socioeconomics

Overall, socioeconomic impacts would be very similar under this alternative as Alternatives 1 and 2. Under this alternative, the cost for developing the desalination facility would be somewhat higher (by about $2 million) due to the cost of installing additional pipeline. The increased cost represents less than 2 percent of the total projected cost for near and long-range water EPWU service projects. The difference in cost would not likely affect future water rates or other socioeconomic factors.

Environmental Justice

As was described for Alternative 1, this alternative is not expected to generate disproportionately high and adverse impacts on minority or low-income populations.

4.10.4 Alternative 4

Socioeconomics

The socioeconomic impacts from this alternative would be essentially the same as described for Alternative 1. Impacts from the few additional jobs (about five jobs) associated with construction and operation of the evaporation ponds would be indistinguishable from the impacts described for Alternative 1.

Environmental Justice

The impacts from this alternative on minority and low-income populations would be similar to those described for Alternative 1. No disproportionately high and adverse impacts are anticipated from disposal of the concentrate in evaporation ponds.

4.10.5 Alternative 5

Socioeconomics

Socioeconomic impacts from this alternative would be the same as from Alternative 4.

Environmental Justice

The impacts from this alternative on minority and low-income populations would be similar to those described for Alternative 1. No disproportionately high and adverse impacts on minority or low-income populations are anticipated.

4.10.6 Alternative 6

Socioeconomics

The impacts on socioeconomics under this alternative would be the same as described for Alternative 4.

Environmental Justice

The impacts from this alternative on minority and low-income populations would be similar to those described for Alternative 1. No disproportionately high and adverse impacts on minority or low-income populations are anticipated.

4.10.7 No Action Alternative

Under the No Action Alternative, EPWU would not invest in developing the proposed desalination facility on Fort Bliss land. Other initiatives planned by EPWU could still continue, and planned increases in water rates would likely still occur. Other changes in employment and earnings associated with the proposed project would not occur. Population growth would likely be the same as under the other alternatives because of the many factors that attract people to a location. The No Action Alternative is not expected to have disproportionately high and adverse impacts on minority and low-income populations.

4.10.8 Mitigation Measures

No socioeconomic or environmental justice mitigation measures are identified.

4.11 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The construction of the proposed desalination plant and support facilities would involve irretrievable commitment of a small quantity of construction materials and petroleum products used by construction equipment. Deep-well injection of concentrate would be essentially irreversible with current technology, and if it resulted in an adverse effect on nearby geothermal resources, those resources, although currently unpromising, could be irretrievably lost. No other irreversible or irretrievable commitments of resources have been identified in connection with the proposed action and alternatives.

4.12 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

If the proposed action (including any of the action alternatives) is implemented, water would continue to be withdrawn from the Hueco Bolson for short-term use at a level that exceeds the aquifer's ability to recharge. This would affect the long-term productivity of that resource. This use would also continue under the No Action Alternative, however, and implementation of the proposed desalination project and use of brackish water from the Bolson is expected to extend the useful life of the aquifer as a freshwater source.

The short-term disturbance of land during construction of the proposed facilities and pipelines would reduce or eliminate the long-term productivity of the land as wildlife habitat. The areas covered by facilities and access roads would be permanently removed, but even areas that are temporarily disturbed by construction activity are unlikely to recover and return to their former level of productivity because of the extremely arid and fragile nature of the environment. The sites affected would be very small in comparison to the availability of the predominant habitat type in the ROI, and the great majority of the sites have limited habitat value.

4.13 CUMULATIVE IMPACTS

Extensive use of the Hueco Bolson Aquifer over the past 50 years has caused considerable drawdown and increasing salinity in the freshwater resource. EPWU has pumped the greatest volume of groundwater from this area of the aquifer, although Fort Bliss has also contributed to the drawdown. Pumping from the feed wells and the new blend wells under the proposed action would more than double (up to 90 feet after 50 years compared to 30-35 feet under the No Action Alternative) the localized drawdown in the immediate vicinity of the feed wells. This would be offset somewhat by decreased drawdown in the areas around wells where pumping is currently planned to be reduced. Nevertheless, the cumulative impact of past, present, and reasonably foreseeable withdrawals from the Hueco Bolson would be continued drawdown of the aquifer. It has been estimated that groundwater levels have fallen 147 feet since 1940. Continued pumping at projected volumes would result in further declines. This would be the case under any of the alternatives analyzed, including the No Action Alternative.

EPWU has planned a number of actions that would develop alternative sources of water and extend its service area. One action involves providing service to the Colonias east of the southern boundary of Fort Bliss either by extending a distribution pipeline or by constructing a desalination plant. The construction of another desalination plant could affect the Hueco Bolson. However, given that no decision has been made as to which alternative will be implemented, the impacts from construction of another desalination plant are not considered reasonably foreseeable.

Other reasonably foreseeable actions that would be taken by EPWU to maintain or increase its ability to provide water, such as importing water from other areas, would occur in other aquifers or would involve surface water supplies. These actions are not anticipated to contribute to adverse environmental impacts on the Hueco Bolson Aquifer or result in cumulatively significant impacts in combination with the proposed action.

Other planned actions in the region of influence include roadway modifications; reasonably foreseeable, but unidentified, public and private construction projects; and actions that may be undertaken by Fort Bliss in the future. Roadway modifications and construction projects would disturb soils and potentially increase the short-term and temporary generation of dust. Fort Bliss is not currently undertaking any projects in the South Training Areas that would affect soils or air quality. Resources potentially affected by the proposed action and alternatives include geology and soils, water resources, biological resources, land use and aesthetics, transportation, and socioeconomics and environmental justice. The identified impacts are generally small or negligible. Similarly, reasonably foreseeable roadway and other construction and Fort Bliss projects are not likely to affect these resources in an appreciable way. The incremental impact of constructing and operating a desalination plant and associated facilities on Fort Bliss land, when added to other past, present, and reasonably foreseeable future actions, would be negligible.

4.14 PROBABLE ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

The environmental impacts identified from the proposed action and alternatives are generally small and not significant. The majority of these relatively minor impacts can be reduced or eliminated through the mitigation measures identified. Unavoidable impacts include the following:

- Installation and use of the proposed blend wells would result in a change in the drawdown pattern of the Hueco Bolson. The drawdown in the vicinity of the feed and blend wells would be unavoidably increased. However, if the total quantity of water withdrawn from the Bolson is not increased, other areas of the aquifer would experience a decrease in the drawdown rate. There would be a risk of increased subsidence in the area of the increased drawdown.
- There would be a small increase in the risk of an earthquake induced by the deep-well injection. The magnitude of the effect is expected to be small and localized. The injection site is remote from most development, so if an earthquake occurred, the damage is expected to be minimal.
- Operation of the desalination plant would result in a minor increase in electricity use.
- Use of construction equipment and ground disturbing activities during construction of the desalination plant and other proposed facilities and pipelines would generate air pollutant emissions and dust and have a short-term, localized effect on air quality. Although the impact can be reduced through watering of exposed soil and other measures, some level of increased emissions is unavoidable.
- Development of a desalination plant would close off the option of using the site for EPIA access and development plans. This would require the airport to revise its plans. This is not considered a significant impact given the uncertainty of those plans (which are being updated), the availability of other options, and the fact that EPIA would need to obtain access to the land from the Army.
- Under Alternatives 4, 5, and 6, approximately 100 tpd of solids from the evaporation ponds would have to be disposed of in an appropriate landfill, which would unavoidably decrease the life of the landfill capacity in the area.
- If Alternative 4, 5, or 6 is selected, there is a possibility that occasional odors from the evaporation ponds would reach mobile homes near the proposed site during certain wind conditions. There is no known mitigation measure for this impact.

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6 LIST OF PREPARERS

Alexander, Matthew L., Environmental Engineer, SAIC
Hazardous Material Waste Management
B.S., Engineering Science and Chemistry
M.S. Chemical Engineering
Ph.D., Chemical Engineering
Years of Experience: 14

Barrera, John F., Fort Bliss Directorate of Environment
Desalination EIS Project Manager, NEPA Program Manager
B.S. Biology
Years of Experience: 30

Baumgartel, Gary, P.E., Civil Engineer, SAIC
Purpose and Need, Alternatives
B.S., Civil Engineering
M.S., Facilities Management
Years of Experience: 29

Bertolin, Gary E., Senior Air Quality Specialist, SAIC
Ph.D., Meteorology and Air Quality
M.S., Atmospheric Science
B.S., Chemistry
Years of Experience: 22

Brandin, Robin M., A.I.C.P., SAIC
Program Manager
M.R.C.P., City and Regional Planning
B.A., Art History
Years of Experience: 30

Burt, **Charles J.,** Senior Biologist, SAIC
Biological Resources
M.S., Forest Zoology
B.S., Biology
Years of Experience: 25

Cartron, **Jean-Luc,** Senior Biologist, SAIC
Biological Resources
Ph.D in Biology
Years of Experience: 12

Corral, Rafael D., Fort Bliss Directorate of Environment
Botanist and Pest Management Coordinator
Ph.D. Environmental Science
M.S. Biology
B.S. Agronomy and Engineering
Years of Experience: 24

Cushing, Elza, Fort Bliss Directorate of Environment
Chief, Multimedia Compliance Division
B.S. Civil Engineering
M.S. Civil Engineering
Years of Experience: 34

Dean, Paul, V., P.E., Senior Chemical Engineer, SAIC
Water Purification, Reverse Osmosis Process
B.S., Chemistry
M.E., Chemical Engineering
Years of Experience: 20

Delgado, Ismael, Fort Bliss Directorate of Environment
Hazardous Waste Management Program Manager
B.S. Civil Engineering
Years of Experience: 20

Dodge, Ira David III, Fort Bliss Directorate of Environment
Defense Environmental Restoration Program Project Manager
M.S. Environmental Engineering
B.S. Civil Engineering
B.A. Mathematics
Years of Experience: 30

Druss, Claudia A., RPA, Senior Archaeologist, SAIC
Cultural Resources
M.A., Anthropology (Archaeology)
B.A., Fine Arts
Years of Experience: 19

Elliott, Benjamin P., P.E., Environmental Engineer, SAIC
Utilities and Services
M.S.E., Petroleum and Geosystems Engineering
B.S., Civil Engineering
B.A., Physical Sciences
Years of Experience: 12

Gordon, **Heather C.,** GIS Technician, SAIC
GIS and Mapping
B.A., Environmental Studies and Planning/Liberal Studies
Years of Experience: 3

Goodan, **Susan M.,** Environmental Planner, SAIC
Visual Resources, Land Use, Transportation, Socioeconomics, and Environmental Justice
M. Architecture
B.A., Ethics/Archaeology
Years of Experience: 11

Hall, Dave, Fort Bliss Directorate of Plans,
Training, Mobilization and Security, Training Support Officer
M.S. Business Administration / Human Relations
B.A. Geology
Years of Experience: 37

Hamilton, Vicki, Fort Bliss Directorate of Environment
Chief, Cultural / Natural Resources Division
M.S. Architecture
B.S. Architecture
Years of Experience: 30

Howard, Steve C., Office Manager/Senior Program Manager, SAIC
Desalination, Alternatives Eliminated from Detailed Study
Civil Engineering
Years of Experience: 29

Jin, Jerry Y., Senior Hydrogeologist, SAIC
Hydrogeology, Senior Review
Executive MBA
Ph.D., Geology
M.S., Geology
B.S., Geology
Years of Experience: 22

Kelly, Robert A., Senior Scientist, SAIC
Deputy Project Manager, Principal Investigator, Biological Resources
Ph.D., Zoology/Ecology
B.S., Biology
Years of Experience: 28

Knopp, John, Fort Bliss Directorate of Environment
NEPA Coordinator
M.S. Environmental Engineering
M.Th. Pastoral Theology
B.S. Civil Engineering
Years of Experience: 26

Landreth, Keith, Fort Bliss Directorate of Environment
Director
M.S. Archeology
B.S. Archeology
Years of Experience: 27

Lenhart, Robert J., Fort Bliss Directorate of Environment
Geologist, Underground Storage Tank Program Manager
Ph.D. Geology
M.S. Geology
B.S. Geology
Years of Experience: 26

Locke, Brian, Fort Bliss Directorate of Environment
Wildlife Biologist
Ph.D. Biology
M.S. Forest Wildlife
B.S. Fisheries and Wildlife Science
Years of Experience: 25

Liu, Angang, Senior Hydrogeologist, SAIC
Geology and Soils
Ph.D., Geology
M.S., Geology
Years of Experience: 25

Manikas, Christopher S., Geologist, SAIC
Water Resources
B.S. Geology
M.S. Geology
Years of Experience: 25

Moncada, Jesus D., Fort Bliss Directorate of Environment
Air Program Manager
B.S. Civil Engineering
M.S. Civil Engineering
Years of Experience: 12

Mulvey, Kelly A., Biologist, SAIC
Transportation, Utilities, Hazardous Material, Hazardous Waste, Administrative Record
B.S., Biology
Years of Experience: 5

Pakiz, James M., CPT, Fort Bliss Office of the Staff Judge Advocate
Environmental Law Attorney J.D. (Law)
B.S. Environmental Science
B.A. German
Years of Experience: 1

Paul, John, R., Fort Bliss USACAS BN
Range Specialist (Safety / Mission Support)
M.A. Human Resource Development
B.A. Psychology
Years of Experience: 38

Raisch, Paul C., Fort Bliss Directorate of Environment
Environmental Scientist, Safe Drinking Water Program Manager
B.S. Biology / Chemistry
Years of Experience: 10

Sitton, **Sue,** Fort Bliss Directorate of Environment
Archaeology Program Manager
M.B.A. Computer Information Systems
M.A. Anthropology
B.A. Accounting
Years of Experience: 25

Williams, John W., Senior Scientist, SAIC
Project Manager
PH.D., Physics
M.S., Physics
B.S., Mathematics
Years of Experience: 31

Wuest, William A., Senior Environmental Scientist, SAIC
Noise and Hazardous Materials, Hazardous Waste, and Safety
M.A., Public Administration
B.S., Political Science
Years of Experience: 36

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7 DISTRIBUTION LIST

U.S. Congress

Jeff Bingaman
U.S. Senator - New Mexico
U.S. Congress
703 Hart Senate Office Building
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2458 Rayburn Hart Office Building
Washington, DC 20515-4323

John Cornyn
U.S. Senator-Texas
U.S. Congress
517 Hart Senate Building
Washington, DC 20510-4323

Pete V. Domenici
Senator-New Mexico
U.S. Senate
328 Hart Senate Office Building
Washington, DC 20510-3101

Duncan Hunter
U.S. Representative
Chairman, House Armed Services Committee
2120 Rayburn House Office Building
Washington, DC 20515

Kay Bailey Hutchison
U.S. Senator – Texas
U.S. Congress
517 Senate Building
Washington, DC 20510-4323

Carl Levin
Ranking Member, U.S. Senate Committee on Armed Services, U.S. Senate
225 Russell Building
Washington, DC 20510

Steve Pearce
U.S. Representative - New Mexico
U.S. Congress
1408 Longworth House Office Building
Washington, DC 20515-4323

Silvestre Reyes
U.S. Representative – Texas
U.S. Congress
1527 Longworth Hart Office Building
Washington, DC 20515-4323

John Warner
Chairman,
U.S. Senate Committee on Armed Services
U.S. Senate
225 Russell Building
Washington, DC 20510

Federal Agencies

Maria Elena Constandse
COCEF/BECC
P.O. Box 221648
El Paso, TX 79913

Filiberto Cortez
Bureau of Reclamation
700 E. San Antonio
Room B-318
El Paso, TX 79901-7020

Arturo Duran
USAADACENFB
Commissioner, U.S. Section – IBWC
4171 N. Mesa, Suite C-100
El Paso, TX 79902-1441

A. Forester Einarsen
NEPA Coordinator
U.S. Army Corps of Engineers/US DoD
Office of Environmental Policy, CECW-PC
441 G Street, NW
Washington, DC 20314-1000

Richard Greene
Regional Administrator,
Environmental Protection Agency
Water Quality Protection Division
Region 6, Main Office
1445 Ross Avenue, Suite 1200
Dallas, TX 75202

Guadalupe Mountains National Park
Superintendent
National Park Service
HC 60, Box 400
Salt Flat, TX 79847-9400

Brian Hanson
U.S. Fish and Wildlife Service
2105 Osuna Rd. NE
Albuquerque, NM 87113-1001

Woodrow W. Irving, Jr.
Bureau of Reclamation
330 Waymore Dr. #54
El Paso, TX 79901

Michael Landis
Bureau of Reclamation Rio Grande Project
700 E. San Antonio
Room B-318
El Paso, TX 79901

Russell Nelson
U.S. EPA Water Quality Commission
Mail Code: 6WQ-EW
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Ed Roberson
Field Office Manager
Bureau of Land Management
Las Cruces Field Office
1800 Marquess
Las Cruces, NM 88005-3371

Kathy Stroud
Repository
U.S. Army Environmental Center, NEPA
Horn Engineering Services, Inc.
2750 Prosperity Avenue, Suite 450
Fairfax, VA 22031

U.S. Fish and Wildlife Service
Field Supervisor
Austin Ecological Services Field Office
10711 Burnet Road, Suite 200
Austin, TX 78758-4460

U.S. Fish and Wildlife Service
Regional Director
P.O. Box 1306
Albuquerque, NM 87103-1306

State Officials and Agencies

Tom Adams
State Single Point of Contact
Texas Governor's Office,
Intergovernmental Coordination
P.O. Box 12428
Austin, TX 78711

Kenneth L. Armbrister
Chairman
Senate Natural Resources Committee
Capitol Station
P.O. Box 12068
Austin, TX 78711

Gonzalo Barrientos
Member
Senate Natural Resources Committee
Capitol Station
P.O. Box 12068
Austin, TX 78711

Scott Campbell
Member
House Natural Resources Committee
Capitol Office
P.O. Box 2910
Austin, TX 78768

Victor Carrillo
Railroad Commissioner
State of Texas
P.O. Box 12967
Austin, TX 78711

Norma Chavez
Texas State Representative
Texas State Legislature
6070 Gateway East, Suite300
El Paso, TX 79905

Archie Clouse
Regional Manager
Texas Commission on Environmental Quality
401 E. Franklin Avenue, Suite 560
El Paso, TX 79901-1206

Robert L. Cook
Executive Director
Texas Parks and Wildlife
Infrastructure Division, Master Planning
4200 Smith School Road
Austin, TX 78744

Ron Curry
Secretary
New Mexico Environment Department
P.O. Box 26110
Santa Fe, NM 87502

John D'Antonio
NM State Engineer
130 South Capitol Street
NEA Building
P.O. Box 25102
Santa Fe, NM 87504-5102

Estevan Lopez
NM Interstate Stream Commission
P.O. Box 25102
Santa Fe, NM 87504

David Dewhurst
Office of the Lieutenant Governor
Capitol Station
P.O. Box 12068
Austin, TX 78711

Robert Duncan
Member
Senate Natural Resources Committee
Capitol Station
P.O. Box 12068
Austin, TX 78711

Gary Esslinger
Treasurer-Manager
Elephant Butte Irrigation District
P.O. Drawer 1509
Las Cruces, NM 88004

Craig Estes
Member
Senate Natural Resources Committee
Capitol Station
P.O. Box 12068
Austin, TX 78711

Pat Haggerty
Texas State Representative
Texas State Legislature
4849 North Mesa Street #206
El Paso, TX 79912

Joe G. Hanson
Rio Grande Compact Commission
P.O. Box 1917
El Paso, TX 79950-1917

Rick Hardcastle
Member
House Natural Resources Committee
Capitol Office
P.O. Box 2910
Austin, TX 78768

Mike Jackson
Vice-Chairman
Senate Natural Resources Committee
Capitol Station
P.O. Box 12068
Austin, TX 78711

Carole Keeton-Strayhorn
Comptroller
State of Texas
P.O. Box 13528, Capitol Station
Austin, TX 78711-3528

Michelle Klaus, Executive Assistant
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744

Tommy Knowles, Ph.D, P.E.
Office of Planning
Texas Water Development Board
1700 N. Congress Ave.
P.O. Box 13231
Austin, TX 78711-3231

Charles R. Matthews
Railroad Commissioner
State of Texas
P.O. Box 12967
Austin, TX 78711

Paul C. Moreno
Texas State Legislature
2314 Montana Avenue
El Paso, TX 79903

Steve Musick
Manager
Texas Commission on Environmental Quality
Water Quality Planning and Assessment
P.O. Box 13087, Section MC-147
Austin, TX 78711-3087

James Narvaez
Elephant Butte Irrigation District
Hydrology Director
530 S. Melendres
Las Cruces, NM 88005

John Nixon
Supervisor
New Mexico Office of the State Engineers
1680 Hickory Loop, Suite 1
Las Cruces, NM 88004-0729

Dianna Noble, P.E.
Environmental Affairs Division
Texas Department of Transportation
125 East 11th Street
Austin, TX 78701-2483

Jerry Patterson
Commissioner
Texas General Land Office
1700 N. Congress Ave., Suite 840
Austin, TX 78701-1495

Rick Perry
Office of the Governor
Capitol Station
P.O. Box 12428
Austin, TX 78711

Joseph C. Pickett
Texas State Representative
Texas State Legislature
1790 Lee Trevino, #307
El Paso, TX 79936

Robert Puente
Chairman
House Natural Resources Committee
Capitol Office
P.O. Box 2910
Austin, TX 78768

Chente Quintanilla
Texas State Representative
Texas State Legislature
120 N. Horizon, Suite A-112
El Paso, TX 79927

Bill Richardson
Office of the Governor
State Capital
Fourth Floor
Santa Fe, NM 87501

Paulina Salopek
NM Interstate Stream Commission
1985 Salopek Road
Las Cruces, NM 88005

Glenn Shankle
Acting Executive Director, MC-109
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

Eliot Shapleigh
Texas State Senator
Texas State Legislature
800 Wyoming, Suite A
El Paso, TX 79902

Kenneth Smith
New Mexico Environment Department
District Manager
Las Cruces District Office
1170 North Solano Drive, Suite M
Las Cruces, NM 88001

Texas Commission on Environmental Quality
Groundwater Assessment Section, MC-147
P.O. Box 13087
Austin, TX 78711-3087

Texas Historical Commission
Department of Antiquities Protection
P.O. Box 12276
Austin, TX 78711-2276

University of Texas- El Paso
Library
500 W. University Ave.
El Paso, TX 79986

Gilbert R. Ward, C.P.G.
Member, Texas Water Development Board
Office of Planning
1700 N. Congress Ave.
Austin, TX 78711-3231

Michael Williams
State of Texas
Railroad Commissioner
P.O. Box 12967
Austin, TX 78711

Karl Wood, Ph.D
NM Water Resources
New Mexico State University
Box 30001 MSC 3167
Las Cruces, NM 88003-8001

Wendy Wyman
Policy Director
Texas Governor's Office of Environmental and Natural Resources
P.O. Box 12428
Austin, TX 78711

Mark Zappa
Resources Law Section
State Bar of Texas Environmental and Natural
4833 Spicewood Springs Road, Suite 202
Austin, TX 78759-8436

Tribes and Tribal Representatives

Mescalero Apache Tribe
Tribal Historic Preservation Officer
Mescalero Apache Tribe
P.O. Box 227
Mescalero, NM 88340

Ysleta del Sur Pueblo
Rick Quezada
War Captain
P.O. Box 17579
El Paso, TX 88006

Local Officials and Agencies

Edmund G. Archuleta, P.E.
El Paso Water Utilities
1154 Hawkins Blvd.
P.O. Box 511
El Paso, TX 79961-0001

Susan Austin
City of El Paso
City Representative, District 1
2 Civic Center Plaza
El Paso, TX 79901

Pat Banegas
Superintendent
Water and Sanitation District
P.O. Box 1751
Anthony, NM 88021

Lorenzo Barrios
Director - President
Homestead Municipal District
3668 Desert Meadows
El Paso, TX 79938

Tom Beard
Chairman, Regional Water Planning Group
Far West Texas Water Planning Group
P.O. Box 668
Alpine, TX 79831

Ravi Bhasker
Mayor, City of Socorro
111 School of Mines Road
P.O. Box K
Socorro, NM 87801

Dolores Briones
El Paso County Judge
500 E. San Antonio, Suite 301
El Paso, TX 79901

Curtis Carr
Hudspeth County Commissioner, District 2
P.O. Box 68
Sierra Blanca, TX 79851-0068

Anthony Cobos
City Representative, District #8
City of El Paso
2 Civic Center Plaza
El Paso, TX 79901-1196

John Cook
City Representative, District #4
City of El Paso
2 Civic Center Plaza
El Paso, TX 79901-1196

Robert A. Cushing
City Representative, District #4
City of El Paso
2 Civic Center Plaza
El Paso, TX 79901

El Paso Border Office
1000 S. El Paso Street
El Paso, TX 79901

Paul Joseph Escobar
City Representative, District #6
City of El Paso
2 Civic Center Plaza
El Paso, TX 79901-1196

Mark Everett
El Paso City-County Health and Environmental
Public Health Administrator
5115 EL Paso Drive
El Paso, TX 79905

Betti Flores
El Paso County Commissioner
500 E. San Antonio
Suite 301
El Paso, TX 79901

Jorge Garcia, Ph.D, P.E
City of Las Cruces
Chief Utilities Engineer Utilities Division
680 Motel Blvd.
Las Cruces, NM 88005

Charles Gonzalez
Mayor, Town of Clint
Town Hall
200 N. San Elizario Road
P.O. Box 350
Clint, TX 79836

Guillermo Ochoa Gonzalez
Paseo San Jeronimo 1665
Esq. Av. Pedro Rosales
De Leon
Fraccionamiento San Jeronimo
Cd. Juarez, CHIH. C.P. 32500

Daniel R. Haggerty
El Paso County Commissioner, Pct. 4
500 East San Antonio
El Paso, TX 79901

Ruth Hooser
County Administrator
Otero County
1000 New York Ave.
Room 101
Alamogordo, NM 88310

Barbara Kauffman
Rio Grande Council of Governments
1100 North Stanton
Suite 610
El Paso, TX 79902

Jim Kiehne
Hudspeth County Commissioner, District 3
P.O. Box 68
Sierra Blanca, TX 0068

Alberto Ramirez Lopez
Junta Municipal
De Agua Y Saneamiento
DE CD. Juarez, CHIH.

Jose Alexandro Lozano
City Representative, District #3
City of El Paso
2 Civic Center Plaza
El Paso, TX 79901

Jorge Magaña, F.A.A.P.
Executive Director
El Paso City-County
Health & Environmental District
5115 El Paso Drive
El Paso, TX 79905

William Michael Mattiace
Mayor, City of Las Cruces
P.O. Box 20000
Las Cruces, NM 88004

Ari Michelsen
Resident Director and Professor
Agricultural Research and Extension Center
1380 A&M Circle
El Paso, TX 79927-5020

Doug Moore
Commissioner, District #1
Otero County
1000 New York Avenue, Room 1
Alamogordo, NM 88310-6935

John Navidomskis
El Paso Co. Water Authority/Horizon
Director – President
1539 Pawling
El Paso, TX 79927

Robert Perez
Vice President
Fabens Water District
P.O. Box 277
Fabens, TX 79838

Daniel S. Power
City Representative, District #5
City of El Paso
2 Civic Center Plaza
El Paso, TX 79901-1196

Minerva Rayos
Manager
Berino Water Association
1158 Berino Road
Mesquite, NM 88048

Carlos A. Rincon
Project Director
1100 N. Stanton
Suite 805
El Paso, TX 79902

Rio Grande Council of Governments
Executive Director
1100 North Stanton
Suite 610
El Paso, TX 79902

Vivian Rojas
City Representative, District #7
City of El Paso
2 Civic Center Plaza
El Paso, TX 79901

George G. Sarmiento, AICP
Planning Director
City of El Paso
2 Civic Center Plaza
El Paso, TX 79901-1196

Carl Schueler
Manager, Planning Division
El Paso County Water Authority
1539 Pawling Drive
El Paso, TX 79927

Charles Scruggs
El Paso County Commissioner, Pct. 1
500 East San Antonio
El Paso, TX 79901

Jose Luis Soria
Director – President
Tornillo Water Supply Co.
P.O. Box 136
Tornillo, TX 79853

Anthony Tarquin
Civil Engineering Department
University of Texas at El Paso
El Paso, TX 79968-0516

Irene Tejeda
Paso Del Norte Water Task Force
1100 N. Stanton, Suite 805
El Paso, TX 79902

Miguel A. Teran
El Paso County Commissioner, Pct. 3
500 East San Antonio
El Paso, TX 79901

Texas Alliance of Groundwater Districts
Mesa Underground Water Conservation District
P.O. Box 497
La Mesa, TX 79331-0497

Texas Association of Counties
Executive Director
P.O. Box 2131
Austin, TX 78768-2131

Joe Wardy
Mayor, City of El Paso
2 Civic Center Plaza
El Paso, TX 79901-1196

Dianne Whitty
Mayor, Town of Horizon City
14999 Darrington Road
Horizon City, TX 79927

Frank D. Wood
Director – President
Haciendas del Norte Water District
13931 Sagebrush Circle
El Paso, TX 79936

Non-Government Organizations

Bill Guerra Addington
Sierra Club, El Paso Group
P.O. Box 218
Sierra Blanca, TX 79851

Daniel C. Allen
Texas Water Utilities Association
1106 Clayton Lane
Suite 101 East
Austin, TX 78723-1093

Kevin Bixby
Rio Grande/Rio Bravo Basin Coalition
Southwest Environmental Center
275 N. Downtown Mall
Las Cruces, NM 88001

Chamber of Commerce of Greater El Paso
10 Civic Center Plaza
El Paso, TX 79901-1196

El Paso Black Chamber of Commerce
1 Texas Tower, 109 N. Oregon Street
El Paso, TX 79901

El Paso Hispanic Chamber of Commerce
201 E. Main
El Paso, TX 79901

Tyrus G. Fain
President
The Rio Grande Institute
P.O. Box 183
Marathon, TX 79842

Jane Fowler
El Paso/ Trans Pecos Audubon Society
P.O. Box 972441
El Paso, TX 79997-2441

Laurence Gibson
Sierra Club, El Paso Group
P.O. Box 9191
El Paso, TX 79983

Leroy Goodson
Texas Water Conservation Association
221 East 9th Street, Suite 206
Austin, TX 78701

Nancy Hanks, Ph.D.
Program Coordinator
Paso del Norte Watershed Council
Agricultural Research & Extension Center
1380 A&M Circle
El Paso, TX 79927-5020

Eva Oporto
Housing Assistant
Greater El Paso Chamber of Commerce
10 Civic Center Plaza
El Paso, TX 79901-1188

Cindy Ramos-Davidson
Hispanic Chamber of Commerce
201 E. Main Street, Suite 100
El Paso, TX 79901

Ben Sebree
Vice President for Governmental Affairs
Texas Oil and Gas Association
304 W. 13th Street
Austin, TX 78701

Sierra Club
Southern New Mexico Group
P.O. Box 3705 UPB
Las Cruces, NM 88011

Karen Sprecher Keating
General Counsel
Fish and Wildlife Foundation
1120 Connecticut Avenue, N.W.
Suite 900
Washington, DC 20036

Public Libraries

El Paso Public Library
501 N. Oregon Street
El Paso, TX 79901

UTEP Library
500 W. University
El Paso, TX 79968

Richard Burges Branch Library
9600 Dyer
El Paso, TX 79924

Westside Branch Library
125 Belvidere Street
El Paso, TX 79912

Irving Schwartz
1865 Dean Martin Drive
El Paso, TX 79936

Private Citizens

John Barnett
1648 Dick Ritter
El Paso, TX 79936

Luis Carlos Talavera
6516 Excondido, Suite #9
El Paso, TX 79912

Ruben Diaz
1737 Tommy Aaron
El Paso, TZ 79936

John Turner
19910 Montana Ave.
El Paso, TX 79938

Ronald C. Glover
4401 N. Mesa
El Paso, TX 79902

Jose G. Gutierrez,
8502 Comet St.
El Paso, TX 79904

Daniel Mezza
600 Navarro
San Antonio, TX 78205

Ofelia Moreno
5301 Timberwolf Drive
El Paso, TX 79903-2129

Bernardino Olague
4110 Rio Bravo, Ste. 201
El Paso, TX 79902

Rick Provencio
4930 Hercules, Apt. 1
El Paso, TX 79907

Isae Salido
540 Palmas
Chaparral, NM 88081

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8 GLOSSARY

Acre-foot (af). The volume of water that covers 1 acre to a depth of 1 foot; approximately 326,000 gallons.

Alluvial fan. A pattern of sediment deposit caused by running water. Fan- or cone-shaped mass of sediment deposited at a point along a stream at which there is a sharp decrease in gradient, such as between a mountain front and a plane.

Alluvium. Any stream-laid sediment deposit.

Ambient Air Quality Standards (AAQS). Standards established on a state or federal level that define the limits for airborne concentrations of designated criteria pollutants (NO_2, SO_2, CO, $PM_{10,}$ O_3, and Pb) to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility, and materials (secondary standards).

Aquifer. A body of rock that contains enough saturated permeable material to transmit groundwater and to yield significant quantities of groundwater to wells and springs.

Aridisol. A soil, formed under conditions of low moisture, that has been in place long enough to have developed distinct layers.

Attainment area. A region that meets the National Ambient Air Quality Standards for a criteria pollutant under the Clean Air Act.

Average annual daily traffic (AADT). For a 1-year period, the total traffic volume passing a point or segment of a highway facility in both directions divided by the number of days in the year.

Blend Water. Brackish water drawn from blend wells that is combined with permeate to produce finished water.

Bolson. An intermontane basin extending from the divide of one block-faulted mountain to the divide of the adjacent mountain, generally with no external drainage, but that may be transected by regional streams.

Brackish. Mixed with salt; salty.

Caliche. Soils with lime-cemented hardpans that result when calcium carbonate and other minerals have been deposited by groundwater into the pores in gravel.

Candidate species. Species for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support the issuance of a proposed rule to list, but issuance of the proposed rule is precluded by higher priority listing actions.

Capacity (traffic). The maximum rate of flow at which vehicles can be reasonably expected to traverse a point or uniform segment of a lane or roadway during a specified time period under prevailing roadway, traffic, and control conditions.

Concentrate. The concentrated brine resulting (along with permeate) from treatment of brackish water by reverse osmosis.

Conductivity. The ease with which water is conducted through a material, expressed as feet per day.

Coppice dunes. Sand dunes characterized by a thicket of woody vegetation.

Criteria pollutants. The Clean Air Act required the U.S. Environmental Protection Agency to set air quality standards for common and widespread pollutants after preparing criteria documents summarizing scientific knowledge on their health effects. Today there are standards for six criteria pollutants: NO_2, SO_2, CO, $PM_{10,}$ O_3, and Pb.

Day-night average sound level (L_{dn}). A-weighted sound-pressure levels averaged over a 24-hour period with 10 decibels (dB) added for events occurring between 10 p.m. and 7 a.m.

Decibel (dB). A standard unit of measuring sound-pressure levels.

Drawdown. The lowering of water level that can occur when large quantities of water are pumped from an aquifer.

Entisol. A young soil with little or no development of distinct layers located in areas where the soil is either actively eroded (by wind or water) or receiving new deposits of soil materials (as occurs with alluvial fans, floodplains, or windblown sand dunes).

Erosion. Processes by which soil and rock are loosened and moved downhill or downwind.

Feed water. Brackish water drawn from feed wells and treated through reverse osmosis to yield permeate and concentrate.

Finished water. Water that has been treated and is ready for distribution.

Fugitive dust. Particulate matter composed of soil. Fugitive dust may include emissions from haul roads, wind erosion of exposed soil surfaces, and other activities in which soil is either removed or redistributed.

Groundwater recharge. Water that infiltrates the land surface and is not lost to evaporation or consumed by plants but that percolates downward and replenishes the groundwater aquifers. This deep percolation is called recharge.

Hazardous material. Any substance or material in a quantity or form that may be harmful to humans, animals, crops, water systems, or other elements of the environment if accidentally released. Hazardous materials include explosives, gases (compressed, liquefied, or dissolved), flammable and combustible liquids, flammable solids or substances, oxidizing substances, poisonous and infectious substances, radioactive materials, and corrosives.

Hazardous waste. Wastes that are designated as hazardous by the U.S. Environmental Protection Agency or state regulations. Hazardous waste, defined under the Resource Conservation and Recovery Act, is waste from production or operation activities that poses a potential hazard to human health or the environment when improperly treated, stored, or disposed. Hazardous wastes appear on special U.S. Environmental Protection Agency lists or possess at least one of the four following characteristics: ignitability, corrosivity, reactivity, and toxicity.

Historic properties. Properties included in or eligible for inclusion in the National Register of Historic Places.

Hydraulic conductivity. The ability of rock, alluvium, or sediment to permit water to flow through it. Technically, it is the volume flow rate of water through a unit cross-sectional area of a porous medium under a unit hydraulic gradient.

Infrastructure. Utilities and other physical support systems needed to operate a facility. Included are electric distribution systems, water supply systems, sewage disposal systems, roads, and so on.

Injection zone. A geologic formation targeted for injection of the concentrate resulting from reverse osmosis.

Level of service (LOS). A qualitative measure describing operational conditions within a traffic stream and how they are perceived by motorists and/or passengers.

Mitigation. A measure used to reduce, eliminate, or compensate for an adverse environmental impact. Mitigation measures can include avoiding the impact altogether by stopping or modifying the proposed action; minimizing impacts by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; compensating for the impact by replacing or providing substitute resources or environments.

National Ambient Air Quality Standards (NAAQS). Federal AAQS established by the U.S. Environmental Protection Agency.

Neotropical migrants. Birds that breed in the temperate zone and then migrate in winter to tropical zones.

Nitrogen dioxide (NO_2). Gas formed primarily from atmospheric nitrogen and oxygen when combustion takes place at high temperature. Nitrogen dioxide emissions contribute to acid deposition and formation of atmospheric ozone (see **Criteria pollutants**).

Nitrogen oxides (NO_x). Gases formed primarily by fuel combustion, which contribute to the formation of acid rain. Nitrogen oxides combine with volatile organic compounds in the presence of sunlight to form ozone (O_3), a major constituent of smog.

Nonattainment area. An area that has been designated by the U.S. Environmental Protection Agency or the appropriate state air quality agency as exceeding one or more national or state AAQS.

Nonpotable. Water that is unsafe or unpalatable to drink because it contains pollutants, contaminants, minerals, or infective agents.

Ozone O_3 (ground level). A major ingredient in smog. O_3 is produced from reactions of volatile organic compounds and nitrogen oxides in the presence of sunlight and heat.

Particulate. Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in air or emissions.

Peak hour. The hour of highest traffic volume on a given section of roadway.

Permeate. Purified water that results from reverse osmosis filtration of brackish feed water.

Pigging station. An above-ground pipe assembly that allows access to below-ground plumbing, typically in order to remove blockages.

Precipitation. Extraction of a substance from the dissolved state.

Reverse osmosis. A method of filtration whereby impure water is pushed under pressure through a semipermeable membrane to produce pure water (or permeate) and a highly concentrated impure solution (or concentrate).

Recharge. Percolation of rainwater and snowmelt through the soil unsaturated zone to the groundwater table.

Riparian. Of or pertaining to the banks of a body of water.

Salinity. Relative concentration of salt in water.

Scoping. Process in the beginning stages of an Environmental Impact Statement (EIS) during which the public and federal and state agencies can identify issues they wish the EIS to address.

Seismicity. The distribution of earthquakes in space and time; a general term for the number of earthquakes in a unit time.

Stratigraphic. Division of geology dealing with the definition and description of rocks and soils, especially sedimentary rocks.

Threatened species. A species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Total dissolved solids (TDS). The concentration of solid materials dissolved in water.

Traditional Cultural Properties (TCP). A legal term referring to properties, regions, or locales used by peoples of Native American heritage in religious, sacred, or ceremonial activities.

Transmissivity. The ease with which groundwater is transmitted through an aquifer. Technically, it is the rate at which groundwater is transmitted through a unit width of an aquifer under a unit hydraulic gradient and corresponds to the hydraulic conductivity multiplied by the saturated thickness of an aquifer.

Unconfined aquifer. An aquifer in which the water table defines the upper limit of the aquifer—also known as a water-table aquifer.

Unemployment rate. The number of civilians, as a percentage of the total civilian labor force, without jobs but actively seeking employment.

Waters of the U.S. A legal term referring to instrastate lakes, rivers, streams (including intermittent streams), mud flats, sand flats, wetlands, playa lakes, and tributaries to such features.

Wetlands. An area that is regularly saturated by surface water or groundwater and subsequently supports vegetation that is adapted for life in saturated soil conditions.

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Appendix A

Reverse Osmosis Desalination

APPENDIX A REVERSE OSMOSIS DESALINATION

Reverse osmosis (RO) is a technique that uses porous membranes to separate fresh water from brackish water or seawater. Fresh water is forced across the membrane under pressure while the membrane acts as a filter or barrier which holds back most of the salt. The amount of fresh water produced depends on a number of factors, including how salty the feed water is, the operating pressure, the type of membrane used, and how many membranes the water passes through.

A.1 THEORY

Osmosis is the passage of a liquid (usually water) into a solution through a membrane that is permeable to the water but not to the salt (or solute) in solution. It is a spontaneous form of diffusion based on the differences (sometimes referred to as a "gradient") in concentrations between the water and the solution; that is, pure(r) water is more concentrated than water and salt, so water crosses the membrane to achieve a balance or equilibrium in the concentration of water. The saltier the water, the greater the osmotic pressure to address the imbalance between pure and salt water.

Osmotic pressure is substantial in nature and accounts for the transport of sap from root systems to the tops of trees. In plants and animals, the cell membrane acts as a diffusion barrier, allowing water and nutrients in but retaining proteins and fats. The membrane is called "semipermeable" if it essentially allows only water to cross.

In RO, pressure is applied to the salt solution to overcome the natural osmotic pressure difference. In that way, water is forced from the salt solution through the membrane to the pure water side. In theory, with enough pressure, virtually all of the water can be forced from the salt solution across the membrane, but considerations such as operating cost and formation of membrane-fouling salt precipitates make that impractical. In addition, no membrane is 100 percent effective in separating salt water from fresh water; higher pressures result in higher quantities of salt crossing the membrane.

In general, the saltier the water is, the smaller the quantity of fresh water that can be practically recovered from it. For example, typical recovery percentages for RO systems desalinating brackish water range from 30 to 80 percent. For comparison, typical seawater recovery percentages range from only 15 to 50 percent.

A.2 FACILITY DESIGN AND EQUIPMENT

RO systems consist of semipermeable membranes formed into tubes so that many membranes are connected to a single treated water (permeate) pipe. The collection of membranes and associated inlet and outlet piping is usually referred to as a module. Modules are typically eight inches in diameter and approximately 40 inches long (a desalination industry standard size). They are usually arrayed horizontally in stacks of six or more modules high, with common distribution and collection header pipes for a number of stacks.

Of the two types of membranes used in desalination plants, polyamide (thin-film composite) membranes have higher flow rates and improved salt rejection; this allows for substantially lower operating pressures—particularly for brackish water applications. Lower operating pressures translate into lower power requirements and operating costs. In addition to pumps to force water across the membranes, other equipment associated with RO desalination facilities include:

- Pretreatment and/or filters to remove turbidity and suspended solids
- Chemical tanks and mixers or injectors to prevent or remove chemical scaling or biological growth

The number and configuration of modules used to generate the desired amount and quality of water have implications for operational procedures and cost. For example, although it may be possible to achieve sufficiently desalinated water in one step, it is generally more cost effective to desalinate all or part of the water in a second consecutive stage. In that way, both stages could be operated at lower pressure, reducing power requirements and reducing the potential for membrane fouling associated with higher operating pressures.

The proposed desalination plant would contain six parallel RO units consisting of 54 first-stage vessels and 22 second-stage vessels, with each vessel consisting of a stack of seven spiral-wound modules. The membranes will be polyamide, and the operating pressure at the first stage will be between 180 and 200 pounds per square inch. The permeate recovery efficiency is anticipated to be between 81 and 83 percent, based on the projected feed water silica concentrations. Because of the anticipated efficiency of salt removal, the permeate will be blended with untreated well water before distribution. The exact proportion is still to be determined, but the estimated proportion is approximately 1.3 parts permeate to one part blend water.

A.3 OPERATION AND MAINTENANCE

Operation and maintenance activities include water conditioning and maintenance of equipment and membranes. Water conditioning includes pretreatment and other steps to prevent membrane fouling, as well as post-treatment to make the water suitable for distribution.

Pretreatment consists of using polypropylene cartridge filters to remove particles larger than 5 microns. To minimize the potential for the formation of scale (e.g., calcium carbonate) in the modules, the pH of the feed water will be lowered with sulfuric acid, converting carbonates in the feed water to carbon dioxide. A sequestering anti-scale agent will be added as well.

Following desalination, chemicals will be added to the blended water to adjust the pH and as a disinfectant before the finished water is conveyed to the distribution system.

Maintenance includes replacement of the pretreatment filters and cleaning of the membranes periodically as required. A membrane cleaning system will remove mineral or organic deposits on the membranes. Acid cleaners are used to remove scale and other inorganic precipitates, whereas alkaline cleaners are used to remove organic fouling. A flushing system will be available to bathe the membranes in fresh water in the event of a power failure, to prevent feed water from remaining stagnant and in contact with the membranes, thereby preventing or minimizing fouling.

Appendix B

Disposition of Concentrate

APPENDIX B DISPOSITION OF CONCENTRATE

The reverse osmosis process for desalinating brackish water produces a very salty brine called "concentrate" that must be disposed of. Desalination of brackish water results in product water and concentrate in proportions that are related to the efficiency of the desalination system and the feed water source. Options under consideration for disposing of the concentrate produced by the proposed desalination plant to be constructed on Fort Bliss include:

- Subsurface deep-well injection
- Evaporation from ponds with disposal of the resulting solids

The proposed desalination plant would treat approximately 18.5 million gallons a day (MGD) of brackish water, producing about 15.5 MGD of treated water, called "permeate," and approximately 3 MGD of concentrate. Based on consideration of available technologies, economic feasibility, and practicality, deep-well injection and surface evaporation ponds are the two alternatives under consideration for concentrate disposal (MC*i*/CDM 2002). Each is described in the following sections.

B.1 DEEP-WELL INJECTION

The placement of liquids deep below the earth's surface is accomplished through injection into a subsurface reservoir or "zone" using wells that penetrate to depths below any usable water resources. The process of deep-well injection relies substantially on identification and characterization of a subsurface zone capable of accepting injected fluid volumes. In locating a potential subsurface zone, consideration is given to the hydrogeologic isolation of the zone, the integrity of the injection wells, regional geological stability, and the locations of the production and injection facilities. The practice of deep-well injection is an established method for disposal of a variety of wastes. In excess of 2 billion gallons of waste per day is injected into subsurface formations in the United States (USEPA 2002).

Deep-well injection involves the construction of appropriately sized vertical wells or well fields that are capable of conveying concentrate more than 2,000 feet below the ground surface. The wells are engineered, constructed, and monitored to precisely direct fluids to the zone under controlled conditions. Design of wells must consider the need to detect loss of well integrity or adverse environmental effects. Additional considerations include minimizing corrosion-related equipment failures and formation damage, as well as ease of maintenance.

Components of an injection well facility consist of one or more wells, an identified injection zone, impermeable boundary layers overlying the zone, influent delivery piping and control facilities, and liquid level and leakage detection and monitoring systems.

A typical injection well (**Figure B-1**) consists of concentric pipes extending more than 2,000 feet below the ground surface into a permeable injection zone that is confined vertically by impermeable strata. The outermost pipe or surface casing extends below the base of any underground sources of drinking water (USDW) and is cemented in place to the surface to prevent fluid loss along the well bore. Directly inside the surface casing, a smaller diameter string casing extends to the injection zone. The string casing is filled with cement to the surface in order to seal off the injected concentrate from the formations above the injection zone. The fluid is injected through the injection tubing inside the long string casing, either through perforations in the long string or in the open hole below the bottom of the long string. The space between the string casing and the injection tube, called the annulus, is filled with an inert, pressurized fluid, and is sealed at the bottom by a removable packer that prevents injected fluid from backing up into the annulus (FRTR 2002). The pressurized annular fluid provides corrosion protection for the casing and is monitored to allow early detection of pressure loss related to casing failure.

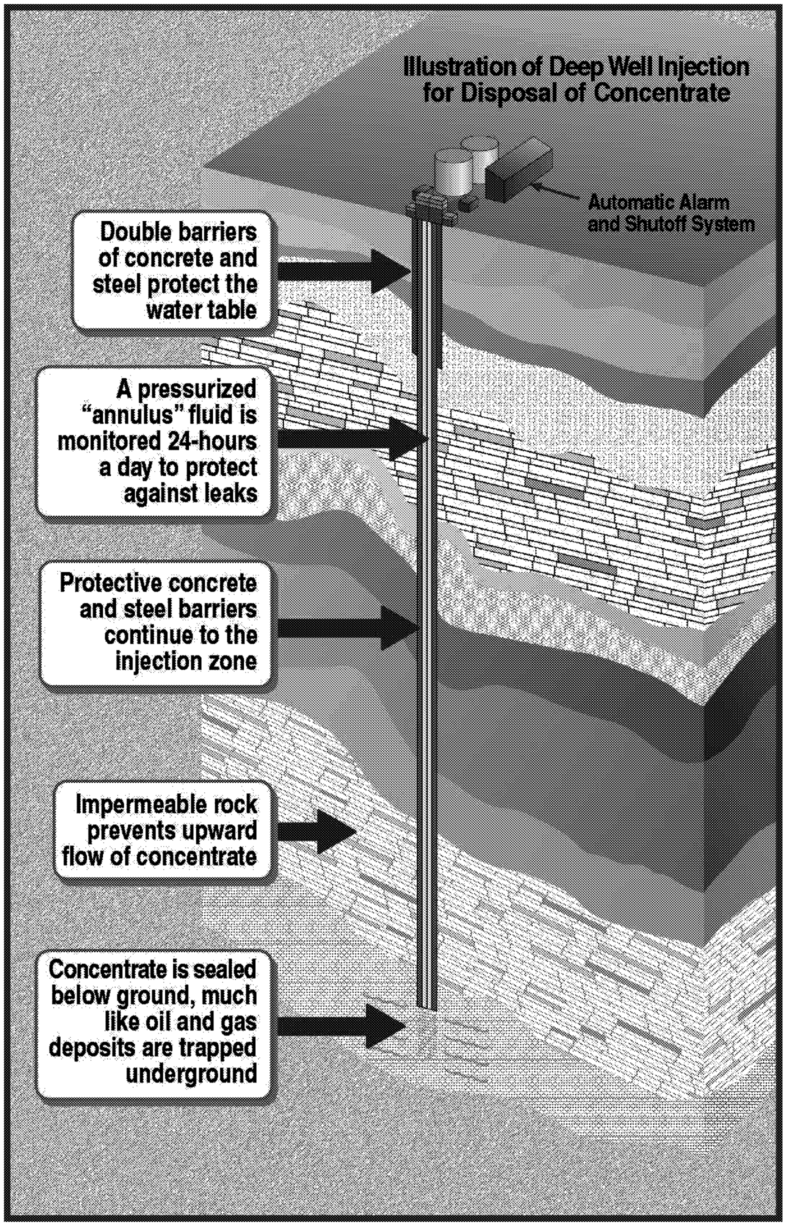

Figure B-1. Schematic Diagram of Typical Deep-Well Injection Installation

B.1.1 Geological/Hydrogeological Considerations

Geologic factors considered in selecting a suitable subsurface location for liquid injection include the capacity of the underground zone to accept and confine the concentrate and the presence or absence of valuable economic mineral resources within the potential area of influence. Suitable subsurface formations capable of receiving the projected concentrate volume and rate of injection must be present and separated from any USDWs present by impermeable layers.

There are three parameters that affect the ability of a geologic unit to receive injected concentrate: 1) its porosity (percentage of open pore space in the rock), 2) its permeability (degree of connectivity of pore spaces), and 3) its thickness. Additional factors that must be considered are the lateral extent and degree of heterogeneity in the injection zone. A thick, laterally continuous stratum with high porosity (storage capacity) through which liquids may pass easily (transmissivity) is most desirable. The target formation should contain sufficient primary and secondary porosity and transmissivity to accommodate the projected concentrate volume over the period (years) of injection. The structural geologic characteristics of a site are important because of their role in influencing subsurface fluid flow, containment of the concentrate, interaction with mineral deposits, and earthquakes. In order to quantitatively evaluate the mechanical response of the subsurface environment to concentrate injection, the engineering properties of the geologic formations comprising the injection zone and confining layers must be assessed. Commonly evaluated formation and fluid properties include (Warner and Lehr 1977):

- Porosity
- Permeability
- Compressibility
- Formation temperature
- Formation water chemistry, viscosity, and density

Concentrate injected into subsurface zones displaces any groundwater present; it does not simply move into empty voids. Injection must occur under pressures greater than the natural formation pressure. The pressure resulting from injection is greatest at the injection well and decreases logarithmically away from the injection point. Injection generally results in the lateral flow of concentrate away from the well into the reservoir formation. Continued injection creates a radius around the well where reservoir pressures are higher within the injection formation. The longer concentrate is injected into the zone, the larger the radius of the induced pressure front. Once away from the area of pressure influence caused by injection, the fluid resumes a natural flow pattern. Flow away from the injection site should generally be radial unless:

- The integrity of the well is compromised;
- A permeability barrier is encountered, such as a non-transmissive fault or fracture, a change occurs in the reservoir rock properties, or thinning of the injection zone occurs against a unit of lower permeability; or
- An avenue of higher permeability is encountered, such as a transmissive fault or fracture, artificial fractures induced in the rock, intersection with an unplugged well bore, or a change in the reservoir rock properties that results in a higher flow rate.

Aside from well failure, the potential for upward migration along a naturally occurring fault plane or fracture zone is probably the most common cause of loss of concentrate confinement. Earthquakes induced by injection of fluids are a documented, although rare, phenomenon.

B.1.2 Concentrate Characteristics

The physical and chemical characteristics of the concentrate have implications for evaluating the suitability of an injection zone, selection of injection well materials and equipment, potential for chemical alteration of the zone's formation, and the subsurface movement of fluids. The characteristics of fluids generally considered in evaluating the suitability for deep-well injection include (Warner and Lehr 1977):

- Wastewater volume
- Physical characteristics (density, viscosity, temperature, suspended solids content, gas content)
- Chemical characteristics (dissolved constituents, pH, chemical stability, reactivity)

Volume

One of the limitations of concentrate injection is the volume of fluid that can be injected over the period of operation. The injection rate of an individual well or well field is limited by the properties of the injection zone (Warner and Lehr 1977). Injection pressure is a limiting factor in the injection rate because excessive pressure increases in the formation can result in hydraulic fracturing with creation of new fluid flow paths and possible damage to the injection zone's confining layers. Depending on the nature and size of the zone, the injection volume can be dissipated across several wells or a well field to distribute the concentrate over a broader area within the zone, increasing the life or utility of individual wells.

Physical Characteristics

The density and viscosity of the concentrate affect its subsurface movement within the zone. The density of the concentrate contributes to the overall injection pressure and affects how the concentrate flows from the injection well. Concentrate lower in density than the existing water in the formation will tend to segregate at the top of the zone, while more dense concentrate will tend to segregate at the bottom. The difference in density between the concentrate and the formation water is important in predicting the distribution of fluids within the zone and the injection pressures needed to achieve storage.

The viscosity of the concentrate is a factor in determining the rate of flow through a porous medium and has an effect on the degree of mixing that occurs between the concentrate and the formation water. Mixing is increased when the viscosity of the concentrate is less than that of the formation water (Warner and Lehr 1977).

Chemical Characteristics

The chemical composition of the concentrate produced by reverse osmosis is higher in total dissolved solids (i.e., dissolved salts and minerals). Dissolved salts influence the corrosivity of water, with corrosiveness generally increasing with salt concentration until it reaches a maximum, after which corrosiveness decreases.

The potential for chemical reactions to occur between the injected concentrate and the formation water is typically evaluated by comparing the dissolved solids composition of the two. Reactions between the injected water and the formation water that form precipitates are not desirable because of the potential for damage to the injection zone. However, interaction of acidic fluids with minerals comprising the zone formation (acid/base reactions) or ion exchange can affect the porosity and permeability of the zone. If the ionic composition of the concentrate is different from that of the formation water, this may provide a means for improving reservoir performance (formation dissolution).

Concentrate pH is an indicator of its potential corrosiveness to equipment or reactivity with the formation. Acidic fluids have been the source of injection system failure due to corrosion and have contributed to well failures through collapse of the borehole after long periods of formation dissolution. Variations in concentrate pH can also initiate precipitation of dissolved salts or mobilization of clay minerals, resulting in porosity and permeability damage to the injection zone.

The pH of the concentrate depends on pre-treatment adjustments made to the feed water and the post-treatment pH adjustments used to make the concentrate compatible with the formation water or reduce the corrosiveness to piping (USEPA 1996).

Chemical stability and reactivity are closely related characteristics that govern the fluid interaction with injection equipment, the injection zone matrix, and the formation water. Chemical stability refers to the distribution and concentration of dissolved constituents relative to their individual properties of solubility, ion complexation, and ionic strength. Chemical stability of dissolved constituents in the concentrate is desirable to reduce the effects of corrosion, precipitation, dissolution, and clay mineral mobility within the injection systems and zone. Chemically unstable concentrate could potentially react with the materials in the injection systems, formation water, and injection zone minerals.

Under the proposed action, the concentrate would be injected into a zone where the existing water is saline, and in order to receive the requisite permits, the chemical characteristics of the concentrate must be similar to the existing water in the injection zone.

B.1.3 Well Design Considerations

Considerations for well design include regulatory standards and requirements and provisions for well construction, monitoring, and abandonment. The U.S. Environmental Protection Agency's Underground Injection Control (UIC) program groups underground injection wells into five classes for regulatory control purposes. The goals of the UIC program are to prevent contamination of usable aquifers by keeping injected fluids within the well and the intended injection zone. These requirements affect the siting, construction, operation, maintenance, monitoring, testing, and the closure of injection wells. All injection wells require authorization under general rules or specific permits, and 33 states, including Texas, have obtained delegation for all classes of injection wells (USEPA 2002). The Texas Commission on Environmental Quality (TCEQ) administers the Texas UIC program.

B.1.4 Summary of Factors Affecting Well Performance and Integrity

Factors that may limit the performance and integrity of a deep injection well system include:

- Seismic activity resulting in loss of well integrity, reservoir displacement or damage, or intrusion of geothermal resources.
- Presence of undocumented, open boreholes or improperly abandoned boreholes.
- Incompatibility of injected concentrate with the mechanical components of the injection well system and the natural formation water.
- Corrosive fluids reacting with the injection well components, with injection zone formation, or with confining strata with undesirable results.
- Elevated iron concentrations resulting in fouling when conditions alter the valence state and convert soluble chemical species to insoluble species.
- Inadequate site assessment and reservoir characterization.

B.2 EVAPORATION PONDS

Evaporation from a free water surface (pond) is influenced by air temperature, wind speed, relative humidity, net solar radiation, vapor pressure in the air and water, and water salinity. In general, increasing water salinity reduces the rate of evaporation, largely because of a reduction in surface water vapor pressure. However, because of variability in the factors influencing evaporation, there is no simple predictive relationship between salinity and evaporation (Mickley 2001). Arid climates offer optimal conditions for evaporation because of the relatively high rate of water evaporation, low rate of precipitation, scarcity of vegetation, deeper groundwater table, and sparse surface water drainage. The availability of sufficient land is also a factor in the feasibility of evaporation ponds as a disposal method. Evaporation is a well-established, low-energy method for disposal of concentrated solutions ultimately resulting in the removal of water vapor and the concentration of solids that are readily landfilled.

Evaporation technologies range from passive solar evaporation, solar gradient pond (convecting, non-convecting) evaporation, mechanical evaporation (misting), and enhanced (forced air, boiling, thermo-oxidation) evaporation methods (Fink 2001). Passive evaporation ponds are the most economical approach to large scale evaporation operations because they require minimal external energy sources for operation, management, and maintenance. Lined evaporation ponds protect surface water and underlying shallow groundwater resources. Construction of a passive evaporation pond is relatively straightforward and is relatively low maintenance, provided adequate quality controls are implemented during construction. Factors to be considered in the design of an effective evaporation pond include regulatory criteria, land requirements and accessibility, pond location, pond size and depth, pond layout, liner selection, influent rate, net evaporation rate, and operating and maintenance costs (MC*i*/CDM 2002; Mickley 2001).

The components of an evaporation pond facility for concentrate disposal consist of a sufficiently sized and engineered impoundment with diking, clay and/or synthetic liners, influent delivery piping and control facilities, liquid level and leakage detection and monitoring systems, and drying areas for the salt residue.

B.2.1 Regulatory Requirements and Environmental Considerations

TCEQ is the state agency in Texas responsible for pollution control, review and approval of plans and specifications for concentrate disposal, and permitting. Environmental considerations for developing an evaporation pond facility are aimed at segregating and containing the concentrate over an extended period.

Protection of surface and subsurface water resources from catastrophic or long-term seepage of concentrate from an evaporation pond must be assured through stringent Quality Control/Quality Assurance (QC/QA) protocols. The QC/QA protocols are implemented during the construction and installation phases of the pond substrate and liner and continue through ongoing environmental monitoring of pond level, liner integrity, erosion control, and shallow groundwater quality. Leachate collection and groundwater wells allow early detection of releases from an evaporation pond.

Brine density has a marked effect on the rate of solar evaporation, as increasing salinity reduces the evaporation rate. This effect may be more pronounced as the ponds age, and estimates suggest a long-term evaporation rate reduction of approximately 30 percent (Mickley 2001) with increasing chemical concentrations.

B.2.2 Concentrate Characterization

The selection of evaporation ponds materials and monitoring parameters is dependent on the physical and chemical composition of the concentrate. Because the influent concentrate solution will be further concentrated through ongoing evaporation, the concentrate is also characterized to estimate the volume of accumulating solids, assess the effects of the concentrate on the pond liner and substrate, and evaluate and maintain concentrate density. Chemical constituents of concern in the concentrated concentrate would consist of inorganic cations and anions and indicator parameters for total dissolved solids, total suspended solids, and pH.

B.2.3 Pond Design Considerations

The operating principle of evaporation ponds is to ensure that evaporation equals or exceeds the volume of influent concentrate. Under given climatic conditions, the rate of evaporation from a pond is governed by pond surface area and depth. Because water evaporation occurs at the pond surface, the rate of evaporation is generally proportional to the surface area of the pond. However, contingencies for surge capacity and water storage, storage of precipitated salts, freeboard for rainfall and wave action, evaporation reduction due to increased pond salinity, and uncertainty in evaporation rate estimates must also be factored into pond design. A critical condition estimate using evaporation data from 1990 indicates that a storage capacity of approximately 3,400 acre-feet would be needed for the projected volume of concentrate from the proposed desalination plant under low evaporation conditions (MC*i*/CDM 2002). The evaporation ponds will be designed to accept continuous influent discharge under all operating conditions so that operation of the desalinization plant would not be restricted. The annual pond influent volume for the proposed plant is estimated at 3,395 acre-feet, based on daily concentrate generation of 3.0 MGD.

Pond Depth

Pond depth is a function of the available land area and the volume of water storage required. Because evaporation occurs at the water surface, shallow ponds are most effective in maximizing the rate of evaporation. Sufficient pond depth is needed, however, to accommodate surge capacity, provide freeboard for rainfall and wave action, and store the precipitated salts. If the surface area of the pond remains unchanged, but depth is allowed to decrease as could occur through salt precipitation, the useful life of the pond could decrease, requiring reestablishing the design depth. Contingency storage to allow for reduced evaporation rates associated with increasing salinity over time is also considered in estimates of pond capacity (Pochop et al. 1985).

Pond Lining

To preclude contamination of shallow groundwater in the vicinity of an evaporation pond, the pond must be design to contain the concentrate through the use of relatively impervious liners. Clay liners with a permeability of 1×10^{-7} centimeters per second or less are generally required on all surfaces that could contain liquid at the pond's maximum capacity. Clay liners without synthetic liners may be susceptible to clay dispersion associated with prolonged concentrate contact, resulting in an increased potential for seepage over time. Synthetic liners are commonly used in concert with clay liners to provide a relatively impervious barrier to concentrate release. Synthetic liners are generally resistant to chemicals, mechanically durable, and can be designed to be resistant to ultraviolet light.

Pond Layout

Criteria for evaluation of evaporation pond layout include:

- Land area
- Operational and maintenance logistics
- Contingencies for excess capacity or pond cleanout
- Pond shape and orientation
- Earthworks

Pond designs are highly variable and range from single-pond to multiple pond configurations; the proposed design for the facility on Fort Bliss is a multiple pond configuration. Multiple pond configurations provide flexibility for maintenance and concentrate control using manageable pond sizes.

Pond Performance and Integrity

Factors affecting the long-term performance and integrity of evaporation systems are related to capacity for storage of concentrate; the integrity of pond dikes, berms, and liners; and management of concentrate concentration and precipitates (residual salts). Routine monitoring of liquid levels within the ponds and regular inspection of berms, dikes, and liners provides an initial indication of compromised infrastructure and potential concentrate loss. The effects of highly saturated concentrate could be detrimental to liner, dike, and berm integrity. Similarly, low liquid levels within a pond may subject the pond liner to desiccation, weathering, and cracking. Periodic disposal of accumulated solids will mitigate the detrimental effects of more concentrated concentrate. Liner breaches associated with physical removal of solids from a pond or berm, or dike failures would allow loss of the concentrate from ponds.

B.2.4 Pond Operation and Maintenance Requirements

During operation, the evaporation ponds must be regularly inspected to ensure they are operating properly and the concentrate is contained. Routine inspections and maintenance activities include:

- Maintenance/repair of berms, dikes, liners, fencing, and piping
- Brine management (removal of solids, concentration, volumes)
- Monitoring (wells, concentrate fluid levels, leachate collection)
- Vegetation control
- Pond security

The integrity of the evaporation pond infrastructure is required to contain the concentrate. Routine visual inspection of liners, dikes, and berms, combined with observations of concentrate fluid levels, provides early indication of potential concentrate loss. Removing solids from the pond bottom is a potentially intrusive activity, and special care must be taken to reduce the possibility of a liner breach during removal or routine maintenance. One complete liner replacement may be anticipated over the life of the pond. Influent pipes are also inspected to ensure that concentrate is not escaping into the environment through piping breaches.

Pond depth is measured periodically to ensure sufficient capacity is available for concentrate and to identify areas of accumulation within the pond. Insufficient storage capacity may require adjustments to discharge rates from the proposed desalination plant and potential reductions in feed well production rates; therefore, pond capacity management is an important component of ongoing operations and maintenance. Management of concentrate chemistry is also important in monitoring evaporation rates that will reduce with increasing chemical concentrations in the ponds.

Monitoring of influent rates to the pond and concentrate levels within the pond, combined with monitoring of groundwater levels surrounding the impoundment and fluid levels in the leachate collection system, provides additional checks to ensure the concentrate is contained. Typically, monitoring of the unsaturated zone in the area near the facility ensures early detection of leaks from the pond.

For safety and security reasons, the entire perimeter of the pond facility would be fenced to restrict access (human and animals), discourage vandalism, and prevent illegal dumping. Routine inspection of security fencing for breaches or undermining are common maintenance requirements.

B.2.5 Regulatory Requirements

Title 30 of the Texas Administrative Code codifies state requirements for environmental quality and is administered by the TCEQ in coordination with other state agencies. The TCEQ classifies concentrate disposal from reverse osmosis treatment systems as industrial waste. Disposal using evaporation pond systems must be conducted in accordance with Title 30 Part 1 administrative rules and specifically *Chapter 309: Domestic Wastewater Effluent Limitation and Plant Siting* and *Chapter 317:Design for Sewerage Systems.*

Appendix C

Texas Commission on Environmental Quality Underground Injection Control Regulations

APPENDIX C TEXAS COMMISSION ON ENVIRONMENTAL QUALITY UNDERGROUND INJECTION CONTROL

CHAPTER 331

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SUBCHAPTER A: GENERAL PROVISIONS

'331.1. Purpose, Scope, and Applicability

(a) The purpose of this chapter is to implement the provisions of the Injection Well Act, Texas Water Code, Chapter 27, as it applies to the commission. The implementation shall be consistent with the policy of this state to: maintain the quality of fresh water in the state to the extent consistent with the public health and welfare and the operation of existing industries, taking into consideration the economic development of the state; prevent underground injection that may pollute fresh water; and require the use of all reasonable methods to implement this policy.

(b) This chapter applies to all injection wells and activities within the commission's jurisdiction.

(c) Exemptions from the prohibition of injection of hazardous waste authorized by 40 Code of Federal Regulations Part 148 are not within the scope of the commission's jurisdiction.

'331.2. Definitions

General definitions can be found in Chapter 3 of this title (relating to Definitions). The following words and terms, when used in this chapter, have the following meanings.

(1) Abandoned well - A well which has been permanently discontinued from use or a well for which, after appropriate review and evaluation by the commission, there is no reasonable expectation of a return to service.

(2) Activity - The construction or operation of an injection well for disposal of waste, or of pre-injection units for processing or storage of waste.

(3) Affected person - Any person whose legal rights, duties, or privileges may be adversely affected by the proposed injection operation for which a permit is sought.

(4) Annulus - The space in the wellbore between the injection tubing and the long string casing and/or liner.

(5) Annulus pressure differential - The difference between the annulus pressure and the injection pressure in an injection well.

(6) Aquifer - A geological formation, group of formations, or part of a formation that is capable of yielding a significant amount of water to a well or spring.

(7) Aquifer restoration - The process used to achieve or exceed water quality levels established by the commission for a permit/production area.

(8) Aquifer storage well - A Class V injection well used for the injection of water into a geologic formation, group of formations, or part of a formation that is capable of underground storage of water for later retrieval and beneficial use.

(9) Area of review - The area surrounding an injection well described according to the criteria set forth in '331.42 of this title (relating to Area of Review) or in the case of an area permit, the project area plus a circumscribing area the width of which is either one fourth of a mile or a number calculated according to the criteria set forth in '331.42 of this title.

(10) Area permit - An injection well permit which authorizes the construction and operation of two or more similar injection wells within a specified area.

(11) Artificial liner - The impermeable lining of a pit, lagoon, pond, reservoir, or other impoundment, that is made of a synthetic material such as butyl rubber, chlorosulfonated polyethylene, elasticized polyolefin, polyvinyl chloride (PVC), other manmade materials, or similar materials.

(12) Baseline quality - The parameters and their concentrations that describe the local groundwater quality of an aquifer prior to the beginning of injection activities.

(13) Baseline well - A well from which groundwater is analyzed to define baseline quality in the permit area (regional baseline well) or in the production area (production area baseline well).

(14) Buffer area - The area between any mine area boundary and the permit area boundary.

(15) Caprock - A geologic formation typically overlying the crest and sides of a salt stock. The caprock consists of a complex assemblage of minerals including calcite (CaCO3), anhydrite

($CaSO_4$), and accessory minerals. Caprocks often contain lost circulation zones characterized by rock layers of high porosity and permeability.

(16) Captured facility - A manufacturing or production facility that generates an industrial solid waste or hazardous waste that is routinely stored, processed, or disposed of on a shared basis in an integrated waste management unit owned, operated by, and located within a contiguous manufacturing complex.

(17) Casing - Material lining used to seal off strata at and below the earth's surface.

(18) Cement - A substance generally introduced as a slurry into a wellbore which sets up and hardens between the casing and borehole and/or between casing strings to prevent movement of fluids within, or adjacent to, a borehole, or a similar substance used in plugging a well.

(19) Cementing - The operation whereby cement is introduced into a wellbore and/or forced behind the casing.

(20) Cesspool - A drywell that receives untreated sanitary waste containing human excreta, and which sometimes has an open bottom and/or perforated sides.

(21) Commercial facility - A Class I permitted facility, where one or more commercial wells are operated.

(22) Commercial underground injection control (UIC) Class I well facility - Any waste management facility that accepts, for a charge, hazardous or nonhazardous industrial solid waste for disposal in a UIC Class I injection well, except a captured facility or a facility that accepts waste only from other facilities owned or effectively controlled by the same person.

(23) Commercial well - An underground injection control Class I injection well which disposes of hazardous or nonhazardous industrial solid wastes, for a charge, except for a captured facility or a facility that accepts waste only from facilities owned or effectively controlled by the same person.

(24) Conductor casing or conductor pipe - A short string of large-diameter casing used to keep the top of the wellbore open during drilling operations.

(25) Cone of influence - The potentiometric surface area around the injection well within which increased injection zone pressures caused by injection of wastes would be sufficient to drive fluids into an underground source of drinking water or freshwater aquifer.

(26) Confining zone - A part of a formation, a formation, or group of formations between the injection zone and the lowermost underground source of drinking water or freshwater aquifer that acts as a barrier to the movement of fluids out of the injection zone.

(27) Contaminant - Any physical, biological, chemical, or radiological substance or matter in water.

(28) Control parameter - Any chemical constituent of groundwater monitored on a routine basis used to detect or confirm the presence of mining solutions in a designated monitor well.

(29) Disposal well - A well that is used for the disposal of waste into a subsurface stratum.

(30) Disturbed salt zone - Zone of salt enveloping a salt cavern, typified by increased values of permeability or other induced anomalous conditions relative to undisturbed salt which lies more distant from the salt cavern, and is the result of mining activities during salt cavern development and which may vary in extent through all phases of a cavern including the post-closure phase.

(31) Drilling mud - A heavy suspension used in drilling an injection well, introduced down the drill pipe and through the drill bit.

(32) Drywell - A well, other than an improved sinkhole or subsurface fluid distribution system, completed above the water table so that its bottom and sides are typically dry except when receiving fluids.

(33) Excursion - The movement of mining solutions into a designated monitor well.

(34) Existing injection well - A Class I well which was authorized by an approved state or EPA-administered program before August 25, 1988 or a well which has become a Class I well as a result of a change in the definition of the injected waste which would render the waste hazardous under '335.1 of this title (relating to Definitions).

(35) Fluid - Material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state.

(36) Formation - A body of rock characterized by a degree of lithologic homogeneity which is prevailingly, but not necessarily, tabular and is mappable on the earth's surface or traceable in the subsurface.

(37) Formation fluid - Fluid present in a formation under natural conditions.

(38) Fresh water - Water having bacteriological, physical, and chemical properties which make it suitable and feasible for beneficial use for any lawful purpose.

(A) For the purpose of this subchapter, it will be presumed that water is suitable and feasible for beneficial use for any lawful purpose only if:

(i) it is used as drinking water for human consumption; or
(ii) the groundwater contains fewer than 10,000 milligrams per liter (mg/L) total dissolved solids; and
(iii) it is not an exempted aquifer.

(B) This presumption may be rebutted upon a showing by the executive director or an affected person that water containing greater than or equal to 10,000 mg/L total dissolved solids can be put to a beneficial use.

(39) Groundwater - Water below the land surface in a zone of saturation.

(40) Groundwater protection area - A geographic area (delineated by the state under the Safe Drinking Water Act, 42 United States Code, '300j-13) near and/or surrounding community and non-transient, non-community water systems that use groundwater as a source of drinking water.

(41) Hazardous waste - Hazardous waste as defined in '335.1 of this title (relating to Purpose, Scope, and Applicability).

(42) Improved sinkhole - A naturally occurring karst depression or other natural crevice found in carbonate rocks, volcanic terrain, and other geologic settings which has been modified by man for the purpose of directing and emplacing fluids into the subsurface.

(43) Injection interval - That part of the injection zone in which the well is authorized to be screened, perforated, or in which the waste is otherwise authorized to be directly emplaced.

(44) Injection operations - The subsurface emplacement of fluids occurring in connection with an injection well or wells, other than that occurring solely for construction or initial testing.

(45) Injection well - A well into which fluids are being injected. Components of an injection well annulus monitoring system are considered to be a part of the injection well.

(46) Injection zone - A formation, a group of formations, or part of a formation that receives fluid through a well.

(47) In service - The operational status when an authorized injection well is capable of injecting fluids, including times when the well is shut-in and on standby status.

(48) Intermediate casing - A string of casing with diameter intermediate between that of the surface casing and that of the smaller long string or production casing, and which is set and cemented in a well after installation of the surface casing and prior to installation of the long string or production casing.

(49) Large capacity cesspool - A cesspool that is designed for a flow of greater than 5,000 gallons per day.

(50) Large capacity septic system - A septic system that is designed for a flow of greater than 5,000 gallons per day.

(51) Licensed professional geoscientist - A geoscientist who maintains a current license through the Texas Board of Professional Geoscientists in accordance with its requirements for professional practice.

(52) Liner - An additional casing string typically set and cemented inside the long string casing and occasionally used to extend from base of the long string casing to or through the injection zone.

(53) Long string casing or production casing - A string of casing that is set inside the surface casing and that usually extends to or through the injection zone.

(54) Lost circulation zone - A term applicable to rotary drilling of wells to indicate a subsurface zone which is penetrated by a wellbore, and which is characterized by rock of high porosity and permeability, into which drilling fluids flow from the wellbore to the degree that the circulation of drilling fluids from the bit back to ground surface is disrupted or "lost."

(55) Mine area - The area defined by a line through the ring of designated monitor wells installed to monitor the production zone.

(56) Mine plan - A map of adopted mine areas and an estimated schedule indicating the sequence and timetable for mining and any required aquifer restoration.

(57) Monitor well - Any well used for the sampling or measurement of any chemical or physical property of subsurface strata or their contained fluids.

(A) Designated monitor wells are those listed in the production area authorization for which routine water quality sampling is required.

(B) Secondary monitor wells are those wells in addition to designated monitor wells, used to delineate the horizontal and vertical extent of mining solutions.

(C) Pond monitor wells are wells used in the subsurface surveillance system near ponds or other pre-injection units.

(58) Motor vehicle waste disposal well - A well used for the disposal of fluids from vehicular repair or maintenance activities, including, but not limited to, repair and maintenance facilities for cars, trucks, motorcycles, boats, railroad locomotives, and airplanes.

(59) New injection well - Any well, or group of wells, not an existing injection well.

(60) New waste stream - A waste stream not permitted.

(61) Non-commercial facility - A Class I permitted facility which operates only non-commercial wells.

(62) Non-commercial underground injection control (UIC) Class I well facility - A UIC Class I permitted facility where only non-commercial wells are operated.

(63) Non-commercial well - An underground injection control Class I injection well which disposes of wastes that are generated on-site, at a captured facility or from other facilities owned or effectively controlled by the same person.

(64) Off-site - Property which cannot be characterized as on-site.

(65) On-site - The same or geographically contiguous property which may be divided by public or private rights-of-way, provided the entrance and exit between the properties is at a cross-roads intersection, and access is by crossing, as opposed to going along, the right-of-way. Noncontiguous properties owned by the same person but connected by a right-of-way which the owner controls and to which the public does not have access, is also considered on-site property.

(66) Out of service - The operational status when a well is not authorized to inject fluids, or the well itself is incapable of injecting fluids for mechanical reasons, maintenance operations, or well workovers or when injection is prohibited due to the well's inability to comply with the in-service operating standards of this chapter.

(67) Permit area - The area owned, or under lease by, the permittee which may include buffer areas, mine areas, and production areas.

(68) Plugging - The act or process of stopping the flow of water, oil, or gas into or out of a formation through a borehole or well penetrating that formation.

(69) Point of injection - For a Class V well, the last accessible sampling point prior to fluids being released into the subsurface environment.

(70) Pollution - The contamination of water or the alteration of the physical, chemical, or biological quality of water:

(A) that makes it harmful, detrimental, or injurious:

(i) to humans, animal life, vegetation, or property; or
(ii) to public health, safety, or welfare; or

(B) that impairs the usefulness or the public enjoyment of the water for any lawful and reasonable purpose.

(71) Pre-injection units - The on-site aboveground appurtenances, structures, equipment, and other fixtures including the injection pumps, filters, tanks, surface impoundments, and piping for wastewater transmission between any such facilities and the well that are, or will be, used for storage or processing of waste to be injected, or in conjunction with an injection operation.

(72) Production area - The area defined by a line generally through the outer perimeter of injection and recovery wells used for mining.

(73) Production area authorization - A document, issued under the terms of an injection well permit, approving the initiation of mining activities in a specified production area within a permit area.

(74) Production zone - The stratigraphic interval extending vertically from the shallowest to the deepest stratum into which mining solutions are authorized to be introduced.

(75) Radioactive waste - Any waste which contains radioactive material in concentrations which exceed those listed in 10 Code of Federal Regulations Part 20, Appendix B, Table II, Column 2, as amended.

(76) Restoration demonstration - A test or tests conducted by a permittee to simulate production and restoration conditions and verify or modify the fluid handling values submitted in the permit application.

(77) Restored aquifer - An aquifer whose local groundwater quality has, by natural or artificial processes, returned to levels consistent with restoration table values or better as verified by an approved sampling program.

(78) Salt cavern - A hollowed-out void space that has been purposefully constructed within a salt stock, typically by means of solution mining by circulation of water from a well or wells connected to the surface.

(79) Salt cavern confining zone - A zone between the salt cavern injection zone and all underground sources of drinking water and freshwater aquifers, that acts as a barrier to movement of waste out of a salt cavern injection zone, and consists of the entirety of the

salt stock excluding any portion of the salt stock designated as an underground injection control (UIC) Class I salt cavern injection zone or any portion of the salt stock occupied by a UIC Class II or Class III salt cavern or its disturbed salt zone.

(80) Salt cavern injection interval - That part of a salt cavern injection zone consisting of the void space of the salt cavern into which waste is stored or disposed of, or which is capable of, receiving waste for storage or disposal.

(81) Salt cavern injection zone - The void space of a salt cavern that receives waste through a well, plus that portion of the salt stock enveloping the salt cavern, and extending from the boundaries of the cavern void outward a sufficient thickness to contain the disturbed salt zone, and an additional thickness of undisturbed salt sufficient to ensure that adequate separation exists between the outer limits of the injection zone and any other activities in the domal area.

(82) Salt cavern solid waste disposal well or salt cavern disposal well - For the purposes of this chapter, regulations of the commission, and not to underground injection control (UIC) Class II or UIC Class III wells in salt caverns regulated by the Texas Railroad Commission, a salt cavern disposal well is a type of UIC Class I injection well used:

(A) to solution mine a waste storage or disposal cavern in naturally occurring salt; and/or

(B) to inject hazardous, industrial, or municipal waste into a salt cavern for the purpose of storage or disposal of the waste.

(83) Salt dome - A geologic structure that includes the caprock, salt stock, and deformed strata surrounding the salt stock.

(84) Salt stock - A geologic formation consisting of a relatively homogeneous mixture of evaporite minerals dominated by halite (NaCl) that has migrated from originally tabular beds into a vertical orientation.

(85) Sanitary waste - Liquid or solid waste originating solely from humans and human activities, such as wastes collected from toilets, showers, wash basins, sinks used for cleaning domestic areas, sinks used for food preparation, clothes washing operations, and sinks or washing machines where food and beverage serving dishes, glasses, and utensils are cleaned.

(86) Septic system - A well that is used to emplace sanitary waste below the surface, and is typically composed of a septic tank and subsurface fluid distribution system or disposal system.

(87) Stratum - A sedimentary bed or layer, regardless of thickness, that consists of generally the same kind of rock or material.

(88) Subsurface fluid distribution system - An assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground.

(89) Surface casing - The first string of casing (after the conductor casing, if any) that is set in a well.

(90) Temporary injection point - A method of Class V injection that uses push point technology (injection probes pushed into the ground) for the one-time injection of fluids into or above an underground source of drinking water.

(91) Total dissolved solids (TDS) - The total dissolved (filterable) solids as determined by use of the method specified in 40 Code of Federal Regulations Part 136, as amended.

(92) Transmissive fault or fracture - A fault or fracture that has sufficient permeability and vertical extent to allow fluids to move between formations.

(93) Underground injection - The subsurface emplacement of fluids through a well.

(94) Underground injection control (UIC) - The program under the federal Safe Drinking Water Act, Part C, including the approved Texas state program.

(95) Underground source of drinking water (USDW) - An "aquifer" or its portions:

(A) which supplies drinking water for human consumption; or

(B) in which the groundwater contains fewer than 10,000 milligrams per liter total dissolved solids; and

(C) which is not an exempted aquifer.

(96) Upper limit - A parameter value established by the commission in a permit/production area authorization which when exceeded indicates mining solutions may be present in designated monitor wells.

(97) Verifying analysis - A second sampling and analysis of control parameters for the purpose of confirming a routine sample analysis which indicated an increase in any control parameter to a level exceeding the upper limit. Mining solutions are assumed to be present in a designated monitor well if a verifying analysis confirms that any control parameter in a designated monitor well is present in concentration equal to, or greater than, the upper limit value.

(98) Well - A bored, drilled, or driven shaft whose depth is greater than the largest surface dimension, a dug hole whose depth is greater than the largest surface dimension, an improved sinkhole, or a subsurface fluid distribution system but does not include any surface pit, surface excavation, or natural depression.

(99) Well injection - The subsurface emplacement of fluids through a well.

(100) Well monitoring - The measurement by on-site instruments or laboratory methods of any chemical, physical, radiological, or biological property of the subsurface strata or their contained fluids penetrated by the wellbore.

(101) Well stimulation - Several processes used to clean the wellbore, enlarge channels, and increase pore space in the interval to be injected thus making it possible for wastewater to move more readily into the formation, including, but not limited to, surging, jetting, blasting, acidizing, and hydraulic fracturing.

(102) Workover - An operation in which a down-hole component of a well is repaired, the engineering design of the well is changed, or the mechanical integrity of the well is compromised. Workovers include operations such as sidetracking, the addition of perforations within the permitted injection interval, and the addition of liners or patches. For the purposes of this chapter, workovers do not include well stimulation operations.

'331.3. Injection Prohibited

(a) Unless excluded under subsection (b) of this section, the construction of an injection well, the conversion of a well into an injection well, and the use or operation of an injection well is prohibited unless authorized by an injection well permit, order, or rule of the commission. A RCRA permit applying the standards of Chapter 335, Subchapter F of this title (relating to Permitting Standards for Owners and Operators of Hazardous Waste Storage, Processing, or Disposal Facilities) will constitute an underground injection control (UIC) permit for hazardous waste injection wells for which the technical standards of this chapter are not generally appropriate.

(b) The following activities are not within the scope of subsection (a) of this section:

(1) injection of waste into subsurface strata via a single family residential cesspool or other device that receives waste, which has an open bottom or perforated sides;

(2) injection of waste into subsurface strata via a septic system well used for single family residential waste disposal.

(c) This rule does not limit the authority of the commission to abate and prevent pollution of fresh water resulting from any injection activity by requiring a permit, by instituting appropriate enforcement action, or by other appropriate action.

'331.4. Mechanical Integrity Required

Injection is prohibited for Class I and III wells which lack mechanical integrity, the result of which may pollute an underground source of drinking water. Except where excluded in the case of authorization by rule, mechanical integrity under '331.43 of this title (relating to Mechanical Integrity Standards) must be demonstrated to the satisfaction of the executive director before operation begins. Injection may be prohibited for Class V wells that lack mechanical integrity. The executive director may require a demonstration of mechanical integrity at any time if there is reason to believe mechanical integrity is lacking. When the executive director determines that a Class I or III well lacks mechanical integrity, the executive director shall give written notice of this determination to the owner or operator. Unless the executive director requires immediate cessation, the owner or operator shall cease injection into the well within 48 hours of receipt of the executive director's determination. The executive director may allow plugging of the well or require the permittee to perform additional construction, operation, monitoring, reporting, and corrective actions which are necessary to prevent the movement of fluid into or between underground sources of drinking water caused by the lack of mechanical integrity. The owner or operator may resume injection upon written notification from the executive director that the owner or operator has demonstrated mechanical integrity.

’331.5. Prevention of Pollution

(a) No permit or authorization by rule shall be allowed where an injection well causes or allows the movement of fluid that would result in the pollution of an underground source of drinking water. A permit or authorization by rule shall include terms and conditions reasonably necessary to protect fresh water from pollution.

(b) Persons authorized to conduct underground injection activities under this chapter shall address unauthorized discharges of chemicals of concern (COCs) from associated tankage and equipment according to the requirements of Chapter 350 of this title (relating to the Texas Risk Reduction Program).

(c) Pre-injection units which are required to be authorized by permit or registration under ’331.7(d) of this title (relating to Permit Required), must be designed, constructed, operated, maintained, monitored, and closed so as not to cause:

(1) the discharge or imminent threat of discharge of waste into or adjacent to the waters in the state without obtaining specific authorization for such a discharge from the commission;

(2) the creation or maintenance of a nuisance; or

(3) the endangerment of the public health and welfare.

’331.6. Prohibition of Class IV Well Injection

The injection of hazardous fluids or radioactive wastes into or above a formation which within one quarter mile of the well contains an underground source of drinking water is prohibited. Wells used to inject hazardous waste-contaminated ground water that is of acceptable quality to aid remediation and is being reinjected into the same formation from which it was drawn are not prohibited by this section if such injection is approved by the commission pursuant to provisions for cleanup of releases consistent with federal regulations under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 United States Code (U.S.C) 9601-9657, or pursuant to provisions for cleanup of releases consistent with federal regulations under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901 through 6987.

’331.7. Permit Required

(a) Except as provided in ’331.9 of this title (relating to Injection Authorized by Rule) and by subsection (d) of this section, all injection wells and activities must be authorized by permit.

(b) For Class III in situ uranium solution mining wells, Frasch sulfur wells, and other Class III operations under commission jurisdiction, an area permit authorizing more than one well may be issued for a defined permit area in which wells of similar design and operation are proposed. The wells must be operated by a single owner or operator. Before commencing operation of those wells, the permittee may be required to obtain a production area authorization for separate production or mining areas within the permit area.

(c) The owner or operator of a large capacity septic system or a septic system which accepts industrial waste must obtain a wastewater discharge permit in accordance with Texas Water Code, Chapter 26 and Chapter 305 of this title (relating to Consolidated Permits), and must submit the inventory information required under '331.10 of this title (relating to Inventory of Wells Authorized by Rule).

(d) Pre-injection units for Class I nonhazardous, noncommercial injection wells and Class V injection wells permitted for the disposal of nonhazardous waste must be either authorized by a permit issued by the commission or registered in accordance with '331.17 of this title (relating to Pre-Injection Units Registration). The option of registration provided by this subsection shall not apply to pre-injection units for Class I injection wells used for the disposal of byproduct material, as that term is defined in Chapter 336 of this title (relating to Radioactive Substance Rules).

'331.8. Prohibition of Motor Vehicle Waste Disposal Wells and Large Capacity Cesspools

Not Applicable

'331.9. Injection Authorized by Rule

(a) Plugging and abandonment of a well authorized by rule at any time after January 1, 1982, shall be accomplished in accordance with the standards of '331.46 of this title (relating to Closure Standards). Class V wells shall be closed according to standards under '331.133 of this title (relating to Closure Standards for Injection Wells). Motor vehicle waste disposal wells, large capacity septic systems, large capacity cesspools, subsurface fluid distribution systems, and drywells shall be closed according to standards under '331.136 of this title (relating to Closure Standards for Motor Vehicle Waste Disposal Wells, Large Capacity Septic Systems, Large Capacity Cesspools, Subsurface Fluid Distribution Systems, and Drywells).

(b) Injection into Class V wells, unless otherwise provided, is authorized by virtue of this rule. Injection into Class V wells used for the disposal of greater than 5,000 gallons per day of sewage or sewage effluent must be authorized by a wastewater discharge permit from the commission under Chapter 305 of this title (relating to Consolidated Permits) before operations begin.

(1) Well authorization under this section expires upon the effective date of a permit issued under '331.7 of this title (relating to Permit Required).

(2) An owner or operator of a Class V well is prohibited from injecting into the well:

(A) upon the effective date of permit denial;

(B) upon failure to submit a permit application in a timely manner under subsection (c) of this section;

(C) upon failure to submit inventory information in a timely manner under '331.10 of this title (relating to Inventory of Wells Authorized by Rule);

(D) upon failure to comply with a request for information from the executive director in a timely manner; or

(E) upon failure to comply with provisions contained in Subchapter H of this chapter (relating to Standards for Class V Wells) and, if applicable, Subchapter K of this chapter (relating to Additional Requirements for Class V Aquifer Storage Wells).

(c) The executive director may require the owner or operator of an injection well authorized by rule to apply for and obtain an injection well permit. The owner or operator shall submit a complete application within 90 days after the receipt of a letter from the executive director requesting that the owner or operator of an injection well submit an application for permit. Cases for which a permit may be required include, but are not limited to, wells not in compliance with the standards required by this section.

(d) Class IV wells injecting hazardous waste-contaminated ground water that is of acceptable quality to aid remediation and that is being reinjected into the same formation from which it was drawn, as authorized by '331.6 of this title (relating to Prohibition of Class IV Well Injection), shall be authorized by rule.

'331.10. Inventory of Wells Authorized by Rule

(a) The owner or operator of an injection well facility, except for those wells listed under subsection (b) of this section, must submit to the executive director prior to construction (or within one year after January 1, 1982 if the well existed on that date), an inventory for each facility containing:

(1) the name of the facility;

(2) the name and address of legal contact;

(3) the ownership of the facility;

(4) the nature, type and operating status of the injection well(s); and

(5) the location, depth, and construction of each well.

(b) Drillers of closed loop and air conditioning return flow injection wells authorized by rule shall inventory wells after construction by submitting the form provided by the executive director as required under '331.132(b)(3) of this title (relating to Construction Standards).

(c) Failure to comply with this section shall constitute grounds for termination of authorization by rule.

(d) Owners or operators of all Class V wells, with the exception of closed loop and air conditioning return flow wells, shall submit the inventory information required under subsection (a) of this section for review, modification, and approval by the executive director. The owner or operator of a Class V well must obtain approval from the executive director prior to construction, conversion, or operation of the well.

(e) Owners and operators of subsurface fluid distribution systems and improved sinkholes in existence on the effective date of this rule must submit the inventory information for these Class V wells to the executive director within one year of the effective date of these rules. Owners and operators of new subsurface fluid distribution systems and improved sinkholes must submit inventory information as required under subsection (d) of this section.

'331.11. Classification of Injection Wells

(a) Injection wells within the jurisdiction of the commission are classified as follows.

(1) Class I:

(A) wells used by generators of hazardous wastes or owners or operators of hazardous waste management facilities to inject hazardous waste, other than Class IV wells;

(B) other industrial and municipal waste disposal wells which inject fluids beneath the lower-most formation which within 1/4 mile of the wellbore contains an underground source of drinking water (USDW); and

(C) radioactive waste disposal wells which inject fluids below the lower-most formation containing a USDW within 1/4 mile of the wellbore.

(2) Class III. Wells which are used for the extraction of minerals, including:

(A) mining of sulfur by the Frasch process; and

(B) solution mining of minerals which includes sodium sulfate, sulfur, potash, phosphate, copper, uranium and any other minerals which can be mined by this process.

(3) Class IV. Wells used by generators of hazardous wastes or of radioactive wastes, by owners or operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites to dispose of hazardous wastes or radioactive wastes into or above a formation which within 1/4 mile of the wellbore contains a USDW.

(4) Class V. Class V wells are injection wells not included in Classes I, II, III, or IV. Generally, wells covered by this paragraph inject nonhazardous fluids into or above formations that contain USDWs. Except for Class V wells within the jurisdiction of the Railroad Commission of Texas, all Class V injection wells are within the jurisdiction of the commission and include, but are not limited to:

(A) air conditioning return flow wells used to return to the supply aquifer the water used for heating or cooling in a heat pump;

(B) closed loop injection wells which are closed system geothermal wells used to circulate fluids including water, water with additives, or other fluids or gases through the earth as a heat source or heat sink;

(C) large capacity cesspools or other devices that receive greater than 5,000 gallons of waste per day, which have an open bottom and sometimes have perforated sides;

(D) cooling water return flow wells used to inject water previously used for cooling;

(E) drainage wells used to drain surface fluid, primarily storm runoff, into a subsurface formation;

(F) drywells used for the injection of wastes into a subsurface formation;

(G) recharge wells used to replenish the water in an aquifer;

(H) salt water intrusion barrier wells used to inject water into a freshwater aquifer to prevent the intrusion of salt water into the fresh water;

(I) sand backfill wells used to inject a mixture of water and sand, mill tailings, or other solids into mined out portions of subsurface mines;

(J) septic systems designed to inject greater than 5,000 gallons per day of waste or effluent;

(K) subsidence control wells (not used for the purpose of oil or natural gas production) used to inject fluids into a non-oil or gas producing zone to reduce or eliminate subsidence associated with the overdraft of fresh water;

(L) aquifer storage wells used for the injection of water for storage and subsequent retrieval for beneficial use;

(M) motor vehicle waste disposal wells which are used or have been used for the disposal of fluids from vehicular repair or maintenance activities, such as an automotive repair shop, auto body shop, car dealership, boat, motorcycle or airplane dealership, or repair facility;

(N) improved sinkholes;

(O) aquifer remediation wells, temporary injection points, and subsurface fluid distribution systems used to inject nonhazardous fluids into the subsurface to aid in the remediation of soil and groundwater; and

(P) subsurface fluid distribution systems.

(b) Class II wells and Class III wells used for brine mining fall within the jurisdiction of the Railroad Commission of Texas.

(c) Baseline wells and monitor wells associated with Class III injection wells within the jurisdiction of the commission are also subject to the rules specified in this chapter.

’331.12. Conversion of Wells

(a) Persons utilizing wells authorized by permit, rule, or otherwise, who wish to convert the well from its authorized purpose to a new or additional purpose must first obtain the appropriate approval described in paragraphs (1) - (4) of this section.

(1) Persons utilizing injection wells authorized by permit must obtain either a permit amendment pursuant to ’305.62 of this title (relating to Amendment), or if appropriate, a permit revocation pursuant to ’305.66 of this title (relating to Permit Denial, Suspension, and Revocation) or ’305.67 of this title (relating to Revocation and Suspension Upon Request or Consent).

(2) Persons utilizing injection wells authorized by rule that are to be converted to a purpose that requires authorization by permit must obtain a permit.

(3) Persons utilizing injection wells authorized by rule that are to be converted to a purpose that does not require authorization by permit must obtain the written approval of the executive director.

(4) Prior to converting a Class V motor vehicle waste disposal well, the owner or operator must inventory the well with the executive director under '331.10 of this title (relating to Inventory of Wells Authorized by Rule) and comply with the conversion requirements under subsection (c) of this section.

(b) Conversions of wells that remain exclusively within the jurisdiction of the Railroad Commission are not affected by this rule. For example, a conversion from a Class II disposal well to a water supply well regulated by the Railroad Commission would neither enter nor exit the jurisdiction of this agency and thus would not be subject to this rule.

(c) In limited cases, the executive director may authorize the conversion of a motor vehicle waste disposal well to another type of Class V well.

(1) The use of a semi-permanent plug as the means to segregate waste is not sufficient to convert a motor vehicle waste disposal well to another type of Class V well.

(2) The executive director may approve the conversion only if:

(A) the well is inventoried with the executive director under '331.10 of this title;

(B) all motor vehicle fluids are segregated by physical barriers and are not allowed to enter the well; and

(C) injection of motor vehicle waste is unlikely based on a facility's compliance history and records showing proper waste disposal.

'331.13. Exempted Aquifer

(a) An exempted aquifer is an aquifer or a portion of an aquifer which meets the criteria for fresh water but which has been designated an exempted aquifer by the commission after notice and opportunity for public hearing. Those aquifers or portions of aquifers which were designated for exemption by the Texas Department of Water Resources in its original application for program approval submitted to the Environmental Protection Agency shall be considered to be exempted aquifers.

(b) Except for injection authorized by rule, the commission may require a permit for injection into an exempted aquifer to protect fresh water outside the exempted aquifer which may be subject to pollution caused by the injection.

(c) An aquifer or portion of an aquifer may be designated as an exempted aquifer if the following criteria are met:

(1) It does not currently serve as a source of drinking water for human consumption; and

(2) Until exempt status is removed according to procedures in subsection (f) of this section, it will not in the future serve as a source of drinking water for human consumption because:

(A) It is mineral, hydrocarbon or geothermal energy bearing with production capability;

(B) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical;

(C) It is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or,

(D) It is located above a Class III well mining area subject to subsidence or catastrophic collapse.

(d) No designation of an exempted aquifer submitted as part of a UIC Program shall be final until approved by the EPA as part of the delegated UIC program.

(e) Subsequent to program approval or promulgation, the commission may, after notice and opportunity for a public hearing, identify additional exempted aquifers.

(f) After notice and opportunity for public hearing, the designation of exempted aquifer may be removed by the commission thereby eliminating the exempt status, provided restoration has been accomplished if required.

'331.14. Prohibition of Class I Salt Cavern Solid Waste Disposal Wells and Associated Caverns in Geologic Structures or Formations Other Than Salt Stocks of Salt Domes and Prohibition of Disposal of Hazardous Waste into Certain Geological Formations

Not Applicable

'331.15. Financial Assurance Required.

Injection is prohibited for Class I and III wells which lack financial assurance, as required by this chapter.

'331.16. Memorandum of Understanding Between the Texas Department of Health and the Texas Natural Resource Conservation Commission Regarding Radiation Control Functions.

Not Applicable

'331.17. Pre-Injection Units Registration

(a) Pre-injection units not otherwise authorized under this chapter must be registered in accordance with the requirements of this section.

(b) No registration shall be approved, and registrations may be denied or revoked, if the executive director determines that:

(1) a pre-injection unit causes or allows the release of fluid that would result in the pollution of underground sources of drinking water, fresh water, or surface water; or

(2) a pre-injection unit poses an immediate threat to public health or safety.

(c) Registration procedures for pre-injection units not otherwise authorized under this chapter must include the following.

(1) The owner or operator shall submit an application for registration to the executive director, in accordance with the applicable requirements of this subchapter;

(A) for any proposed pre-injection unit, obtain approval of the registration before operating the pre-injection unit; or

(B) for any existing unauthorized pre-injection unit, submit the application on or before the date the injection well permit renewal application is submitted.

(2) The owner or operator shall cease operation of any pre-injection unit if:

(A) the registration application for an existing pre-injection unit has not been submitted before approval of the injection well permit renewal;

(B) renewal of the registration is denied by the executive director;

(C) the term of the registration expires, however, if registration renewal procedures have been initiated before the permit expiration date, the existing registration will remain in full force and effect and will not expire until commission action on the application for renewal of the registration is final;

(D) the registration is denied or revoked by the executive director; or

(E) the executive director determines that the unit poses an immediate threat to public health or safety.

(d) Design criteria are as follows:

(1) pre-injection units shall be designed in such a manner as to protect underground sources of drinking water, fresh water, and surface water from pollution;

(2) pre-injection units shall be designed in such a manner as to enable the authorized injection well to meet all permit conditions and applicable rules and law;

(3) pre-injection units shall meet the design standards contained in Chapter 317 of this title (relating to Design Criteria for Sewerage Systems) which apply to the type of unit being proposed; and

(4) all ponds shall be lined according to the requirements of '331.47 of this title (relating to Pond Lining).

'331.18. Registration Application, Processing, Notice, Comment, Motion to Overturn

(a) Applicability. This section sets forth the requirements for applications and the manner in which action will be taken on applications filed for a registration for pre-injection units.

(b) Contents of application. Registration applications for pre-injection units must include:

(1) complete application form(s), signed and notarized, and required number of copies provided;

(2) the verified legal status of the applicant(s) as applicable;

(3) the signature of the applicant(s), in accordance with the requirements of '305.44 of this title (relating to Signatories to Applications);

(4) a notarized affidavit from the applicant(s) verifying land ownership or landowner agreement to the proposed activity. Pre-injection unit registration information on file with the commission shall be confirmed or updated, in writing, no later than 30 days after:

(A) the mailing address and/or telephone number of the owner or operator is changed; or

(B) requested by the commission or executive director;

(5) maps showing:

(A) the name and address of persons who own the property on which the existing or proposed pre-injection unit is or will be located, if different from the applicant; and

(B) the name and address of landowners adjacent to the property on which the pre-injection unit is located or is proposed to be located.

(6) plans and specifications of the pre-injection units which have the seal of a professional engineer licensed in the State of Texas. The engineer shall certify that the submission meets the applicable technical requirements of Chapter 317 of this title (relating to Design Criteria for Sewerage Systems);

(7) the attachment of technical reports and supporting data required by the application; and

(8) any other information the executive director or the commission may reasonably require.

(c) Administrative completeness. Upon receipt of an application for a registration, the executive director or his designee shall assign the application a number for identification purposes. Applications for registrations shall be reviewed by the staff for administrative completeness within the period specified by '281.3(a) of this title (relating to Initial Review).

(d) Technical completeness. When the application is declared to be technically complete, the executive director or his designee shall prepare a statement of the receipt of the application and declaration of technical completeness which is suitable for mailing and shall forward that statement to the chief clerk. The chief clerk shall notify every person entitled to notification as stated in subsection (e) of this section. The notice of receipt of an application for registration and declaration of technical completeness shall contain the following information:

(1) the location of the pre-injection unit;

(2) the identifying number given the application by the executive director;

(3) the type of registration sought under the application;

(4) the name, address, and telephone number of the applicant and the name and address of the agency and the telephone number of an agency contact from whom interested persons may obtain further information about the application to register the unit;

(5) the date on which the application was submitted;

(6) a brief summary of the information included in the application;

(7) a statement that the registration application has been provided to the county judge and that it is available for review by interested parties;

(8) a brief description of public comment procedures; and

(9) the deadline to file public comment. The deadline shall be not less than 30 days after the date notice is mailed.

(e) Notice requirements.

(1) The public notice requirements of this subsection apply to new applications for a registration, and to applications for major amendment or renewal of a registration for pre-injection units.

(2) The chief clerk of the commission shall mail Notice of Receipt of Application and Technical Completeness, along with a copy of the registration application, to the county judge in the county where the pre-injection unit is located or proposed to be located.

(3) The chief clerk of the commission shall mail Notice of Receipt of Application and Technical Completeness to the adjacent landowners named on the application map or supplemental map, or the sheet attached to the application map or supplemental map.

(f) Application processing procedures. Any person who is required to obtain approval of a registration, or who requests an amendment, modification, or renewal of a registration for pre-injection units is subject to the application processing procedures and requirements found in Chapter 281 of this title (relating to Application Processing).

(g) Major amendment. A major amendment is an amendment that changes a substantive term, provision, requirement, or a limiting parameter of a registration. Notice requirements of subsection (e) of this section are applicable to major amendments.

(h) Minor amendment. A minor amendment is an amendment to improve or maintain the quality or method of management of waste, and includes any other change to a registration issued under this chapter that will not cause or relax a standard or criterion which may result in a potential deterioration of quality of waters in the state. Notice requirements of subsection (e) of this section are not applicable to minor amendments.

(i) Public comment on registrations. A person may provide the commission with written comments on any new, major amendment, or renewal applications to register pre-injection units. The executive director shall review any written comments received within the public comment period. The written information received shall be utilized by the executive director in determining what action to take on the application for registration, in accordance with ’331.17 of this title (relating to Registration of Pre-Injection Units). After the deadline for submitting public comment, the executive director may take final action on the application.

(j) Delegation, effective date of registration, term. The commission delegates to the executive director the authority to approve pre-injection unit registrations. The effective date for the registration of a site at which pre-injection units are located is the date that the executive director by letter, approves the application. The term for registration shall not exceed ten years and shall be synchronized with the term of the injection well permit.

(k) Motion to overturn. The applicant or a person affected may file with the chief clerk a motion to overturn the executive director's final approval of an application, under '50.139(b) - (f) of this title (relating to Motion to Overturn).

'331.19. Injection Into or Through the Edwards Aquifer

Not Applicable

'331.21. Required Submission of Geoscientific Information

All geoscientific information submitted to the agency under this chapter shall be prepared by, or under the supervision of, a licensed professional geoscientist or a licensed professional engineer and shall be signed, sealed, and dated by the licensed professional geoscientist or licensed professional engineer in accordance with the Texas Geoscience Practice Act and the Texas Engineering Practice Act.

SUBCHAPTER C: GENERAL STANDARDS AND METHODS

'331.41. Applicability

The provisions of this subchapter set forth standards and requirements that apply to all Class I and Class III wells, unless specifically excluded.

'331.42. Area of Review

(a) The area of review is the area surrounding an injection well or a group of injection wells, for which the permit application must detail the information required in Subchapter G of this title (relating to Consideration Prior to Permit Issuance).

(b) The area of review is:

(1) for Class I wells, an area determined by a radius of 2 1/2 miles from the proposed or existing wellbore, or the area within the cone of influence, whichever is greater;

(2) for salt cavern disposal wells and associated caverns, the sum of the two following areas:

(A) an area determined by a radius of 2 1/2 miles from the proposed or existing wellbore; and

(B) the greatest horizontal plane cross-sectional area of the salt dome between land surface and a depth of 1,000 feet below the projected floor of the proposed or existing salt cavern;

(3) for Class III wells, the project area plus a circumscribing area, a minimum of 1/4 mile, the width of which is the lateral distance from the perimeter of the project area, in which the pressures in the injection zone may cause the migration of the injection and/or formation fluid into a USDW; or

(4) for Class V wells, an area determined by a radius of at least 1/4 mile from the proposed or existing wellbore.

(c) The computation of the cone of influence may be based upon the parameters listed in the figure in this subsection and should be calculated for an injection time period equal to the expected life of the injection well or pattern. The following modified Theis equation illustrates one form that the mathematical model may take:

$$\mathbf{r = (2.25\ KHht / S10^{x})^{2}}$$

Where:

$x = 4\pi\ KH (h_w - h_{bo} \times S_pG_b) / 2.3\ Q$
r = radius of endangering influence from injection well (length)
K = hydraulic conductivity of the injection zone (length/time)
H = thickness of the injection zone (length)
t = time of injection (time)
S = storage coefficient (dimensionless)
Q = injection rate (volume/time)
h_{bo} = observed original hydrostatic head of injection zone (length) measured from the base of the lowermost underground source of drinking water
h_w = hydrostatic head of underground source of drinking water (length) measured from the base of the lowest underground source of drinking water
S_pG_b = specific gravity of fluid in the injection zone (dimensionless)
π = 3.142 (dimensionless)

The above equation is based on the following assumptions:

(1) the injection zone is homogenous and isotropic;

(2) the injection zone has infinite area extent;

(3) the injection well penetrates the entire thickness of the injection zone;

(4) the well diameter is infinitesimal compared to Ar@ when injection time is longer than a few minutes; and

(5) the emplacement of fluid into the injection zone creates instantaneous increase in pressure.

(d) After an appropriate review, the commission may modify the area of review. In no event shall the boundary of an area of review be less than 2 1/2 miles for Class I wells or l/4 mile from any other injection well covered by the appropriate authorization. The following factors are to be included in the review:

(1) Chemistry of injection and formation fluids;

(2) Hydrogeology;

(3) Population and its dependence on ground water use; and

(4) Historical practices in the area.

(e) The executive director may require an owner or operator of an existing injection well to submit any reasonably available information regarding the area of review, if the information would aid a review for the prevention or correction of freshwater pollution.

’331.43. Mechanical Integrity Standards

(a) An injection well has mechanical integrity if:

(1) there is no significant leak in the casing, tubing, or packer, and

(2) if there is no significant fluid movement through vertical channels adjacent to the injection wellbore.

(b) A salt cavern has integrity if it:

(1) has no anomalies or irregularities that would prevent optimum cavern filling or that would prevent the cavern from holding pressure; and

(2) has no pressure communication or fluid flow between other caverns or formations outside the salt stock. The tests to show salt cavern integrity shall consist of cavern pressure and sonar tests, or other tests approved by the executive director, to determine the geometric shape of the unfilled cavern.

(c) Methods and standards approved by the EPA through federal Underground Injection Control Program delegation to the commission, shall be applied in conducting and evaluating the tests required by this section.

(d) When the owner or operator reports the results of mechanical integrity tests to the executive director, he shall include a description of the test(s) and the method(s) used. In making his/her evaluation, the executive director shall review monitoring and other test data submitted since the previous evaluation.

(e) The executive director may require additional or alternative tests if the results presented by the owner or operator under subsection (d) of this section are not satisfactory to the executive director to demonstrate that there is no movement of fluid into or between USDWs resulting from the injection activity.

’331.44. Corrective Action Standards

(a) Corrective action standards for all wells. In determining the adequacy of corrective action proposed or required to prevent or correct pollution of underground sources of drinking waters (USDWs), and fresh or surface water, the following factors shall be considered:

(1) toxicity and volume of the injected fluid;

(2) toxicity of native fluids and by-products of injection;

(3) population potentially affected;

(4) geology and hydrology;

(5) history of the injection operation;

(6) completion and plugging records;

(7) abandonment procedures in effect at the time a well was abandoned;

(8) hydraulic connections with USDWs, and fresh or surface water;

(9) reliability of the procedures used to identify abandoned wells;

(10) any other factors which might affect the movement of fluids into or between USDWs; and

(11) for Class III wells only, when setting corrective action requirements the executive director shall consider the overall effect of the project on the hydraulic gradient in potentially affected USDWs, and the corresponding changes in potentiometric surfaces(s) and flow directions(s) rather than the discrete effect of each well. If a decision is made that corrective action is not necessary based on the determinations in this paragraph, the monitoring program required in '331.84 of this title (relating to Monitoring Requirements) shall be designed to verify the validity of those determinations.

(b) Additional corrective action standards for Class I wells.

(1) For such wells within the area of review which are in the opinion of the executive director inadequately constructed, completed, plugged, or abandoned, or for which plugging or completion information is unavailable, the applicant shall also submit a plan consisting of such steps or modifications as are necessary to prevent movement of fluids into or between USDWs or freshwater aquifers. Where such a plan is adequate, the commission shall incorporate it into the permit as a condition. Where the executive director's review of an application indicates that the permittee's plan is inadequate the executive director shall:

(A) require the applicant to revise the plan;

(B) prescribe a plan for corrective action as a condition of the permit; or

(C) deny the application.

(2) The criteria of subsection (a) of this section will be used to determine adequacy.

(3) Any permit issued for a Class I well which was authorized prior to August 25, 1988, by an approved state program or an EPA-administered program or a well which has become a Class I well as a result of a change in the definition of the injected waste which would render the waste hazardous under '331.2 of this title (relating to Definitions) and which require corrective action other than pressure limitations shall include a compliance schedule requiring any corrective action accepted or prescribed under this section. Any such compliance schedule shall provide for compliance no later than two years following issuance of the permit and shall require observance of appropriate pressure limitations under paragraph (b)(4) of this subsection until all other corrective action measures have been implemented.

(4) As part of the corrective action plan, the commission may impose an injection pressure limitation that does not cause the pressure in the injection zone to be sufficient to drive fluids into or between USDWs or freshwater aquifers in those wells described in subsection (a) of this section, which condition shall expire upon adequate completion of all corrective action measures.

(5) Action prescribed by a corrective action plan for new wells or new areas must be completed to the satisfaction of the executive director before operation of the well begins.

(6) In the event that, after an authorization for injection has been granted, additional information is submitted or discovered that a well within the applicable area of review might pose a hazard to a USDW or freshwater aquifer, the commission may prescribe a corrective action plan and compliance schedule as a condition for continued injection activities.

(7) If at any time the operator cannot assure the continuous attainment of the performance standard in '331.62(5)of this title (relating to Construction Standards), the executive director may require a corrective action plan and compliance schedule. The operator must demonstrate compliance with the performance standard, as a condition for receiving approval of continued operation of the well. The executive director also may require permit changes to provide for additional testing and/or monitoring of the well to insure the continuous attainment of the performance standard. The commission may order closure of the well if the operator fails to demonstrate, to the executive director's satisfaction, that the performance standard is satisfied.

'331.45. Executive Director Approval of Construction and Completion

The executive director may approve or disapprove the construction and completion for an injection well or project. In making a determination whether to grant approval, the following shall be reviewed for compliance with the standards of this chapter:

(1) for Class I wells, other than salt cavern disposal wells and associated salt caverns:

(A) actual as-built drilling and completion data on the well;

(B) all logging and testing data on the well;

(C) a demonstration of mechanical integrity;

(D) anticipated maximum pressure and flow rate at which the permittee will operate;

(E) results of the injection zone and confining zone testing program as required in '331.62(7) of this title (relating to Construction Standards) and '331.65(a) of this title (relating to Pre-operation Reports);

(F) the actual injection procedure;

(G) the compatibility of injected waste with fluids in the injection zone and minerals in both the injection zone and the confining zone and materials used to construct the well;

(H) the calculated area of review and cone of influence based on data obtained during logging and testing of the well and the formation, and where necessary, revisions to the information submitted under '331.121 of this title (relating to Class I Wells);

(I) the status of corrective action required for defective wells in the area of review;

(J) compliance with the casing and cementing performance standard in '331.62(5) of this title, and where necessary, changes to the permit to provide for additional testing and/or monitoring of the well to insure the continuous attainment of the performance standard; and

(K) compliance with the cementing requirements in '331.62(6).

(2) for salt cavern disposal wells and associated salt caverns:

(A) actual as-built drilling and completion data on the well;

(B) all logging, coring, and testing program data on the well and salt pilot hole;

(C) a demonstration of mechanical integrity of the well;

(D) the anticipated maximum wellhead and casing seat pressures and flow rates at which the well will operate during cavern development and cavern waste filling;

(E) results of the salt cavern injection zone and salt cavern confining zone testing program as required in '331.163(e)(3) of this title (relating to salt cavern solid waste disposal wells).

(F) the injection and production procedures for cavern development and cavern waste filling;

(G) the compatibility of injected materials with the contents of the salt cavern injection zone and the salt cavern confining zone, and with the materials of well construction;

(H) land subsidence monitoring data and groundwater quality monitoring data, including determinations of baseline conditions for such monitoring throughout the area of review;

(I) the status of corrective action required for defective wells in the area of review;

(J) actual as-built specifications of the well's surface support and monitoring equipment; and

(K) conformity of the constructed well system with the plans and specifications of the permit application.

(3) for Class III wells:

Not Applicable

'331.46. Closure Standards

(a) For Class I wells, other than salt cavern disposal wells, prior to closing the well, the owner or operator shall observe and record the pressure decay for a time specified by the executive director. The executive director shall analyze the pressure decay and the transient pressure observations conducted pursuant to '331.64 of this title (relating to Class I Wells) and determine whether the injection activity has conformed with predicted values.

(b) For all Class I wells, including salt cavern disposal wells, prior to well closure, appropriate mechanical integrity testing shall be conducted to ensure the integrity of that portion of the long string casing and cement that will be left in the ground after closure. Testing methods may include:

(1) pressure tests with liquid or gas;

(2) radioactive tracer surveys for wells other than salt cavern disposal wells;

(3) noise logs, temperature logs, pipe evaluation logs, cement bond logs, or oxygen activation logs; and

(4) any other test required by the executive director.

(c) For Class I wells, other than salt cavern disposal wells, prior to well closure the well shall be flushed with a non-hazardous buffer fluid.

(d) In closure of all Class I wells, including salt cavern disposal wells, Class III wells, and permitted Class V wells, a well shall be plugged in a manner which will not allow the movement of fluids through the well, out of the injection zone either into or between underground sources of drinking waters (USDWs) or to the land surface. Well plugs shall consist of cement or other materials approved in writing by the executive director, which provide protection equivalent to or greater than that provided by cement.

(e) The permittee shall notify the executive director before commencing closure according to an approved plan. For Class I wells this notice shall be given at least 60 days before commencement. At the discretion of the executive director, a shorter notice period may be allowed. The executive director shall review any revised, updated, or additional closure plans.

(f) Placement of the plugs in the wellbore shall be accomplished by an approved method that may include one of the following:

(1) the balance plug method;

(2) the dump bailer method;

(3) the two-plug method; or

(4) an alternate method, approved by the executive director, that will reliably provide a comparable level of protection.

(g) Prior to closure, the well shall be in a state of static equilibrium with the mud or nonhazardous fluid weight equalized top to bottom, either by circulating the mud or fluid in the well at least once or by a comparable method prescribed by the executive director.

(h) Each plug used shall be appropriately tagged and tested for seal and stability before closure is completed.

(i) The closure plan shall, in the case of a Class III production zone that underlies or is in an exempted aquifer, also demonstrate that no movement of contaminants that will cause pollution from the production zone into a USDW or freshwater aquifer will occur. The commission shall prescribe aquifer cleanup and monitoring where deemed necessary and feasible to ensure that no migration of contaminants that will cause pollution from the production zone into a USDW or freshwater aquifer will occur.

(j) The following shall be considered in determining the adequacy of a plugging and abandonment plan for Class I and III wells:

(1) the type and number of plugs to be used;

(2) the placement of each plug including the elevation of the top and bottom;

(3) the type, grade, and quantity of plugging material to be used;

(4) the method of placement of the plugs;

(5) the procedure used to plug and abandon the well;

(6) any newly constructed or discovered wells, or information, including existing well data, within the area of review;

(7) geologic or economic conditions;

(8) the amount, size, and location by depth of casings and any other materials left in the well;

(9) the method and location where casing is to be parted if applicable;

(10) the estimated cost of the plugging procedure; and

(11) such other factors that may affect the adequacy of the plan.

(k) For Class I wells only, a monument or other permanent marker shall be placed at or attached to the plugged well before abandonment. The monument shall state the permit number, date of abandonment, and company name.

(l) Each owner of a Class I hazardous waste injection well, and the owner of the surface or subsurface property on or in which a Class I hazardous waste injection well is located, must record, within 60 days after approval by the executive director of the closure operations, a notation on the deed to the facility property or on some other instrument which is normally examined during a title search that will, in perpetuity, provide any potential purchaser of the property the following information:

(1) the fact that land has been used to manage hazardous waste;

(2) the name of the state agency or local authority with which the plat was filed, as well as the Austin address of the Underground Injection Control (UIC) staff of the commission, to which it was submitted; and

(3) the type and volume of waste injected, the injection interval or intervals, and for salt cavern wells, the maximum cavern radius into which it was injected, and the period over which injection occurred.

(m) Within 30 days after completion of closure, the permittee shall file with the executive director a closure report on forms provided by the commission. The report shall be certified as accurate by the owner or operator and by the person who performed the closure operation (if other than the owner or operator). This report shall consist of a statement that the well was closed in accordance with the closure plan previously submitted and approved by the executive director. Where the actual closure differed from the plan previously submitted, a written statement shall be submitted specifying the differences between the previous plan and the actual closure.

(n) For salt cavern disposal wells, prior to sealing the cavern and plugging the well, the owner or operator shall complete any pre-closure monitoring of the cavern and its contents required by rule or permit.

(o) For salt cavern disposal wells, the cavern shall be closed according to '331.170 of this title (relating to Cavern Closure).

(p) The obligation to implement the closure plan survives the termination of a permit or the cessation of injection activities. The requirement to maintain and implement an approved plan is directly enforceable regardless of whether the closure plan requirement is a condition of the permit.

'331.47. Pond Lining

(a) Except as provided in subsection (b) of this section, all holding ponds, emergency overflow ponds, emergency storage ponds, or other surface impoundments associated with, or part of the pre-injection units associated with underground injection wells shall be lined with clay or an artificial liner as approved by the executive director or as required by permit, and shall in addition, conform to any applicable requirements of Chapter 335 of this title (relating to Industrial Solid Waste and Municipal Hazardous Waste).

(b) All surface impoundments for nonhazardous, noncommercial Class 1 industrial waste associated with Class I nonhazardous, noncommercial injection wells, or Class V injection wells permitted for the disposal of nonhazardous waste, shall meet the design standards contained in Chapter 317 of this title (relating to Design Criteria for Sewerage Systems) which apply to surface impoundments.

'331.48. Waiver of Requirements (for Class III and Class V Wells Only)

(a) When injection does not occur into, through or above an underground source of drinking water, the commission by permit may authorize a well with less stringent requirements than those required in this chapter to the extent that the less stringent requirements will not result in an increased likelihood of movement of fluid that may pollute USDWs, and fresh or surface water.

(b) When injection occurs and a cone of depression centered at the well or well field is maintained for the injection zone, the commission by permit may authorize a well with less stringent requirements for operation, monitoring, and reporting than those required in this chapter to the extent that the less stringent requirements will not result in an increased likelihood of movement of fluid that may pollute USDWs, and fresh or surface water.

(c) When requirements are reduced under subsection (a) or (b) of this section, a technical summary will be prepared setting forth the basis for the action.

SUBCHAPTER D: STANDARDS FOR CLASS I WELLS OTHER THAN SALT CAVERN SOLID WASTE DISPOSAL WELLS

'331.61. Applicability

The sections of this subchapter apply to all Class I injection wells, other than salt cavern wells, unless otherwise noted.

'331.62. Construction Standards

All Class I wells shall be designed, constructed, and completed to prevent the movement of fluids that could result in the pollution of an underground source of drinking water (USDW).

(1) Design criteria. Casing and cement used in the construction of each newly drilled well shall be designed for the life expectancy of the well, including the post-closure care period. The well shall be designed and constructed to prevent potential leaks from the well, to prevent the movement of fluids along the wellbore into or between USDWs, to prevent the movement of fluids along the wellbore out of the injection zone, to permit the use of appropriate testing devices and workover tools, and to permit continuous monitoring of injection tubing, long string casing, and annulus, as required by this chapter. All well materials must be compatible with fluids with which the materials may be expected to come into contact. A well shall be deemed to have compatibility as long as the materials used in the construction of the well meet or exceed standards developed for such materials by the American Petroleum Institute, the American Society for Testing Materials, or comparable standards acceptable to the executive director.

(A) Casing design. Surface casing shall be set to a minimum subsurface depth, as determined by the executive director, which extends into the confining bed below the lowest formation containing a USDW or freshwater aquifer. At least one long string casing, using a sufficient number of centralizers, shall extend to the injection interval. In determining and specifying casing and cementing requirements, the following factors shall be considered:

(i) depth of lowermost USDW or freshwater aquifer;
(ii) depth to the injection interval;
(iii) injection pressure, external pressure, internal pressure, and axial loading;
(iv) hole size;
(v) size and grade of all casing strings (wall thickness, diameter, nominal weight, length, joint specification, and construction material);
(vi) the maximum burst and collapse pressures, and tensile stresses which may be experienced at any point along the length of the casings at any time during the construction, operation, and closure of the well;
(vii) corrosive effects of injected fluids, formation fluids, and temperatures;
(viii) lithology of injection and confining intervals;
(ix) presence of lost circulation zones or other subsurface conditions that could affect the casing and cementing program;
(x) types and grades of cement; and
(xi) quantity and chemical composition of the injected fluid.

(B) Tubing and packer design. All Class I injection wells shall inject fluids through tubing with a packer, set at a depth specified by the executive director. Fluid seal systems will not be approved by the commission. The annulus system shall be designed and constructed to prevent the leak of injection fluids into any unauthorized zones. In determining and specifying requirements for tubing and packer, the following factors shall be considered:

(i) depth to the injection zone;
(ii) characteristics of injection fluid (chemical content, corrosiveness, temperature, and density);
(iii) injection pressure;
(iv) annular pressure;
(v) rate (intermittent or continuous), temperature, and volume of injected fluid;
(vi) size of casing; and
(vii) tensile, burst, and collapse strengths of the tubing.

(2) Plans and specifications. Except as specifically required in the terms of the disposal well permit, the drilling and completion of the well shall be done in accordance with the requirements of this chapter and all permit application plans and specifications.

(3) Changes to plans and specifications. Any proposed changes to the plans and specifications must be approved in writing by the executive director that said changes provide protection standards equivalent to or greater than the original design criteria.

(A) If during the drilling and/or completion of the well, the operator proposes to change the cementing of the surface casing, the executive director shall require a written description of the proposed change, including any additional data necessary to evaluate the request. The operator may not execute the change until the executive director gives written approval. The operator may change the setting depth of the surface casing to a depth greater than that specified in the permit, either during drilling and/or completion, without approval from the executive director. Approval for setting depths shallower than specified in the permit will not be authorized.

(B) If the operator proposes to change the injection interval to one not reviewed during the permit application process, the operator shall submit an application to amend the permit. The operator may not inject into any unauthorized zone.

(C) Any other changes, including but not limited to the number of casing strings, changes in the size or material of intermediate and production casings, changes in the completion of the well, changes in the exact setting of screens or injection intervals within the permitted injection zone, and changes in the type of cement used, or method of cementing shall be considered minor changes. If minor changes are requested, the executive director may give immediate oral and subsequent written approval or written approval for those changes. The operator is required to submit a detailed written description of all minor changes, along with the information required in '331.65 of this title (relating to Reporting Requirements), before approval for operation of the well may be granted.

(4) Drilling requirements.

(A) The well shall be drilled according to sound engineering practices to minimize problems which may jeopardize completion attempts, such as deviated holes, washouts and stuck pipe.

(B) As much as technically practicable and feasible, the hole should be drilled under laminar flow conditions, with appropriate fluid loss control, to minimize hole washouts.

(C) Immediately prior to running casing, the drilling fluid in the hole is to be circulated and conditioned to establish rheological properties commensurate with proper cementing practices.

(5) Construction performance standard. All Class I wells shall be cased and all casings shall be cemented to prevent the movement of fluids along the borehole into or between USDWs or freshwater aquifers, and to prevent movement of fluids along the borehole out of the injection zone.

(6) Cementing requirements, for all Class I wells constructed after the promulgation of this rule, including wells converting to Class I status.

(A) Cementing shall be by the pump and plug or other method approved by the executive director. Cementing may be accomplished by staging. Cement pumped shall be of a volume equivalent to at least 120% of the volume calculated necessary to fill the annular space between the hole and casing and between casing strings to the surface of the ground. The executive director may require more than 120% when the geology or other circumstances warrant it. A two-dimensional caliper shall be used to measure the hole diameter. If the two-dimensional caliper can not measure the diameter of the hole over an interval, then the minimum amount of cement needed for that interval shall be a volume calculated to be equivalent to or greater than 150% of the space between the casing and the maximum measurable diameter of the caliper.

(B) If lost circulation zones or other subsurface conditions are anticipated and/or encountered, which could result in less than 100% filling of the annular space between the casing and the borehole or the casings, the owner/operator shall implement the approved contingency plan submitted according to '331.121(a)(2)(O) of this title (relating to Class I Wells).

(7) Logs and tests.

(A) Integrity testing. Appropriate logs and other tests shall be conducted during the drilling and construction of Class I wells. All logs and tests shall be interpreted by the service company which processed the logs or conducted the test; or by other qualified persons. A minimum of the following logs and tests shall be conducted:

(i) deviation checks on all holes, conducted at sufficiently frequent intervals to assure that avenues for fluid migration in the form of diverging holes are not created during drilling;

(ii) for surface casing;

(I) spontaneous potential, resistivity, natural gamma, and caliper logs before the casing is installed;

(II) cement bond with variable density log, and temperature logs after casing is set and cemented; and

(III) any other test required by the executive director;

(IV) the executive director may allow the use of an alternate to subclauses (I) and (II) of this clause when an alternative will provide equivalent or better information; and

(iii) for intermediate and long string casing:

(I) spontaneous potential, resistivity, natural gamma, compensated density and/or neutron porosity, dipmeter/fracture finder, and caliper logs, before the casing is installed;

(II) a cement bond with variable density log, casing inspection, and temperature logs after casing is set and cemented, and an inclination survey; and

(III) any other test required by the executive director; and

(iv) a mechanical integrity test consisting of:

(I) a pressure test with liquid or gas;

(II) a radioactive tracer survey;

(III) a temperature or noise log;

(IV) a casing inspection log, if required by the executive director; and

(V) any other test required by the executive director.

(B) Pressure tests. Surface casing shall be pressure tested to 1,000 pounds per square inch, gauge (psig) for at least 30 minutes, and long string casing shall be tested to 1,500 psig for at least 30 minutes, unless otherwise specified by the executive director.

(C) Core samples. Full-hole cores shall be taken from selected intervals of the injection zone and lowermost overlying confining zone; or, if full-hole coring is not feasible or adequate core recovery is not achieved, sidewall cores shall be taken at sufficient intervals to yield representative data for selected parts of the injection zone and lowermost overlying confining zone. Core analysis shall include a determination of permeability, porosity, bulk density, and other necessary tests.

(8) Injectivity tests. After completion of the well, injectivity tests shall be performed to determine the well capacity and reservoir characteristics. Surveys shall be performed to establish preferred injection intervals. Prior to performing injectivity tests, the bottom hole pressure, bottom hole temperature, and static fluid level shall be determined, and a representative sample of formation fluid shall be obtained for chemical analysis. Information concerning the fluid pressure, temperature, fracture pressure and other physical and chemical characteristics of the injection and confining zones shall be determined or calculated.

(9) Construction and workover supervision. All phases of well construction and all phases of any well workover shall be supervised by qualified individuals acting under the responsible charge of a licensed professional engineer or licensed professional geoscientist, as appropriate, with current registration under the Texas Engineering Practice Act or Texas Geoscience Practice Act, who is knowledgeable and experienced in practical drilling engineering and who is familiar with the special conditions and requirements of injection well construction.

(10) The executive director shall have the opportunity to witness all cementing of casing strings, logging and testing. The owner or operator shall submit a schedule of such activities to the

executive director at least 30 days prior to commencing drilling of the well. The executive director shall be given at least 24 hour notice before each activity in order that a representative of the executive director may be present.

’331.63. Operating Requirements

(a) All Class I wells shall be operated to prevent the movement of fluids that could result in the pollution of an underground source of drinking water (USDW) and to prevent leaks from the well into unauthorized zones.

(b) Except during well stimulation, injection pressure at the wellhead shall not exceed a maximum which shall be calculated so as to assure that the pressure in the injection zone during injection does not initiate new fractures or propagate existing fractures in the injection zone, initiate new fractures or propagate existing fractures in the confining zone, or cause movement of fluid out of the injection zone that may pollute USDWs or surface water.

(c) Injection between the outermost casing protecting USDWs and fresh or surface water and the wellbore is prohibited.

(d) The annulus between the tubing and long string casing shall be filled with a non-corrosive or corrosion-inhibiting fluid approved by the commission. The annulus pressure shall be at least 100 psi greater than the injection tubing pressure to prevent leaks from the well into unauthorized zones and to detect well malfunctions, unless the executive director determines that such a requirement might harm the integrity of the well.

(e) Monthly average and maximum instantaneous rates of injection, and annual and monthly volumes of injected fluids shall not exceed limits specified by the commission.

(f) All gauges, pressure sensing, and recording devices shall be tested and calibrated quarterly.

(g) Any chemical or physical characteristic of the injected fluids shall be maintained within specified permit limits for the protection of the injection well, associated facilities, and injection zone and to ensure proper operation of the facility.

(h) The permittee shall notify the executive director before commencing any workover operation. The notification shall be in writing and shall include plans for the proposed work. Approval by the executive director shall be obtained before the permittee may begin the workover. The executive director may grant an exception to the prior written notification and permission requirements when immediate action is required to comply with subsection (a) of this section.

(i) Pressure control equipment shall be installed and maintained during workovers which involve the removal of tubing.

(j) For workovers or testing operations on hazardous waste disposal wells, all hazardous fluids shall be flushed from the wellbore with a non-hazardous fluid before conducting any portion of the operations which would result in the exposure of the hazardous wastes to the environment or the public.

(k) The owner or operator shall maintain mechanical integrity of the injection well at all times.

(l) The owner or operator of an injection well that has ceased operations for more than two years and is subject to 30 TAC '305.154(a)(7) of this title (relating to Standards) shall notify the executive director in writing 30 days prior to resuming operation of the well.

'331.64. Monitoring and Testing Requirements.

(a) Injection fluids shall be sampled and analyzed with a frequency sufficient to yield representative data of their characteristics;

(1) The owner or operator shall develop and follow an approved written waste analysis plan that describes the procedures to be carried out to obtain a detailed chemical and physical analysis of a representative sample of the waste, including the quality assurance procedures used. At a minimum, the plan shall specify:

(A) the parameters for which the waste will be analyzed and the rationale for the selection of these parameters;

(B) the test methods that will be used to test for these parameters; and

(C) the sampling method that will be used to obtain a representative sample of the waste to be analyzed.

(2) The owner or operator shall repeat the analysis of the injected wastes as described in the waste analysis plan and when process or operating changes occur that may significantly alter the characteristics of the waste stream.

(3) The owner or operator shall conduct continuous or periodic monitoring of selected parameters as required by the executive director.

(4) The owner or operator shall assure that the plan remains accurate and the analyses remain representative.

(b) Pressure gauges shall be installed and maintained, at the wellhead, in proper operating conditions at all times on the injection tubing and on the annulus between the tubing and long-string casing, and/or annulus between the tubing and liner;

(c) Continuous recording devices shall be installed, used, and maintained in proper operating condition at all times to record injection tubing pressures, injection flow rates, injection fluid temperatures, injection volumes, tubing-long string casing annulus pressure and volume, and any other data specified by the permit. The instruments shall be housed in weatherproof enclosures. The owner or operator shall also install and use:

(1) automatic alarm and automatic shutoff systems, designed to sound and shut-in the well when pressures and flow rates or other parameters approved by the executive director exceed a range and/or gradient specified in the permit; or

(2) automatic alarms designed to sound when the pressures and flow rates or other parameters approved by the executive director exceed a rate and/or gradient specified in the permit, in cases where the owner or operator certifies that a trained operator will be on location and able to immediately respond to alarms at all times when the well is operating.

(3) If an automatic alarm or shutdown is triggered, the owner or operator shall immediately investigate as expeditiously as possible the cause of the alarm or shutoff. If, upon investigation, the well appears to be lacking mechanical integrity, or if monitoring otherwise indicates that the well may be lacking mechanical integrity, the owner or operator shall:

(A) cease injection of waste fluids unless authorized by the executive director to continue or resume injection;

(B) take all necessary steps to determine the presence or absence of a leak; and

(C) notify the executive director within 24 hours after the alarm or shutdown.

(4) If the loss of mechanical integrity is discovered by monitoring or during periodic mechanical integrity testing, the owner or operator shall:

(A) immediately cease injection of waste fluids;

(B) take all steps reasonably necessary to determine whether there may have been a release of hazardous wastes or hazardous waste constituents into any unauthorized zone;

(C) notify the executive director within 24 hours after the loss of mechanical integrity is discovered;

(D) notify the executive director when injection can be expected to resume; and

(E) restore and demonstrate mechanical integrity to the satisfaction of the executive director prior to resuming injection of waste fluids.

(5) Whenever the owner or operator obtains evidence that there may have been a release of injected wastes into an unauthorized zone;

(A) the owner or operator shall immediately cease injection of waste fluids; and

(i) notify the executive director within 24 hours of obtaining such evidence;
(ii) take all necessary steps to identify and characterize the extent of any release;
(iii) propose a remediation plan for executive director review and approval;
(iv) comply with any remediation plan specified by the executive director;
(v) implement any remediation plan approved by the executive director; and
(vi) where such release is into a USDW or freshwater aquifer currently serving as a water supply, within 24 hours, notify the local health authority, place a notice in a newspaper of general circulation, and send notification by mail to adjacent landowners.

(B) the executive director may allow the operator to resume injection prior to completing cleanup action if the owner or operator demonstrates that the injection operation will not endanger USDWs or freshwater aquifers.

(d) Mechanical integrity testing

(1) The integrity of the long string casing, injection tube, and annular seal shall be tested annually by means of an approved pressure test with a liquid or gas and whenever there has been a well workover. The integrity of the bottom-hole cement shall be tested annually by means of an approved radioactive tracer survey. A radioactive tracer survey may be required after workovers that have the potential to damage the cement within the injection zone.

(2) A temperature log, noise log, oxygen activation log, or other approved log shall be required by the executive director at least once every five years to test for fluid movement along the borehole.

(3) A casing inspection, casing evaluation, or other approved log shall be run whenever the owner or operator conducts a workover in which the injection string is pulled, unless the executive director waives this requirement due to well construction or other factors which limit the test=s reliability, or based upon the satisfactory results of a casing inspection log run within the previous five years. The executive director may require that a casing inspection log be run every five years, if there is sufficient reason to believe the integrity of the long string casing of the well may be adversely affected by naturally occurring or man-made events.

(4) The executive director may allow the use of a test to demonstrate mechanical integrity other than those listed in paragraph (1) of this subsection with the written approval of the administrator of the United States Environmental Protection Agency (EPA) or his authorized representative. To obtain approval, the executive director shall submit a written request to the EPA administrator, which shall set forth the proposed test and all technical data supporting its use. The EPA administrator shall approve the request if it will reliably demonstrate the mechanical integrity of wells for which its use is proposed. Any alternate method approved by the EPA administrator shall be published in the Federal Register and may be used unless its use is restricted at the time of approval by the EPA administrator.

(e) Any wells within the area of review selected for the observation of water quality, formation pressure, or any other parameter, shall be monitored at a frequency sufficient to protect USDWs, and fresh or surface water.

(f) Corrosion monitoring.

(1) Corrosion monitoring of well materials shall be conducted quarterly. Test materials shall be the same as those used in the injection tubing, packer, and long string casing, and shall be continuously exposed to the waste fluids with the exception of when the well is taken out of service. The owner or operator shall demonstrate that the waste stream will be compatible with the well materials with which the waste is expected to come into contact, and to submit to the executive director a description of the methodology used to make that determination. Compatibility for purposes of this requirement is established if contact with injected fluids will not cause the well materials to fail to satisfy any design requirement imposed under '331.62(1) of this title (relating to Design Criteria). Testing shall be by:

(A) placing coupons of the well construction materials in contact with the waste stream; or

(B) routing the waste stream through a loop constructed with the material used in the well; or

(C) using an alternative method approved by the executive director.

(2) The test shall use materials identical to those used in the construction of the well, and those materials must be continuously exposed to the operating pressures and temperatures (measured at the wellhead) and flow rates of the injection operation; and

(3) The owner or operator shall monitor the materials for loss of mass, thickness, cracking, pitting, and other signs of corrosion on a quarterly basis to ensure that the well components meet the minimum standards for material strength and performance set forth in '331.62(1) of this title (relating to Construction Standards).

(4) Corrosion monitoring may be waived by the executive director if the injection well owner or operator satisfactorily demonstrates, before authorization to conduct injection operations, that the waste streams will not be corrosive to the well materials with which the waste is expected to come into contact throughout the life of the well. The demonstration shall include a description of the methodology used to make that determination.

(g) Ambient monitoring.

(1) Based on a site-specific assessment of the potential for fluid movement from the well or injection zone and on the potential value of monitoring wells to detect fluid movement, the executive director shall require the owner or operator to develop a monitoring program. When prescribing a monitoring system, the executive director may also require:

(A) Continuous monitoring for pressure changes in the first aquifer overlying the confining zone. When a monitor well is installed, the owner or operator shall, on a quarterly basis, sample the aquifer and analyze for constituents specified by the executive director;

(B) the use of indirect, geophysical techniques to determine the position of the waste front, the water quality in a formation designated by the executive director, or to provide other site specific data;

(C) periodic monitoring of the ground water quality in the first aquifer overlying the injection zone;

(D) periodic monitoring of the ground water quality in the lowermost USDW; and

(E) any additional monitoring necessary to determine whether fluids are moving into or between USDWs.

(2) The pressure buildup in the injection zone shall be monitored annually, including at a minimum, a shut down of the well for a time sufficient to conduct a valid observation of the pressure fall-off curve.

(h) Any other monitoring and testing requirements which the executive director determines to be necessary including but not limited to monitoring for seismic activity.

(i) The owner or operator shall submit information demonstrating to the satisfaction of the executive director that the waste stream and its anticipated reaction products will not alter the permeability, thickness, or other relevant characteristics of the confining or injection zones such that they would no longer meet the requirements specified in '331.121(c) of this title (relating to Class I Wells).

'331.65. Reporting Requirements

(a) Pre-operation reports. For new wells, including wells converting to Class I status, the requirements are as follows.

(1) Completion report. Within 90 days after the completion or conversion of the well, the permittee shall submit a Completion Report to the executive director. The report must include a surveyor's plat showing the exact location and giving the latitude and longitude of the well. The report must also include a certification that a notation on the deed to the facility property or on some other instrument which is normally examined during title search has been made stating the surveyed location of the well, the well permit number, and its permitted waste streams. The permittee shall also include in the report the following, prepared and sealed by a licensed professional engineer or licensed professional geoscientist with current registration under the Texas Engineering Practice Act or Texas Geoscience Practice Act:

(A) actual as-built drilling and completion data on the well;

(B) all logging and testing data on the well;

(C) a demonstration of mechanical integrity;

(D) anticipated maximum pressure and flow rate at which the permittee will operate;

(E) results of the injection zone and confining zone testing program as required in '331.62 of this title (relating to Construction Standards) and this subsection;

(F) adjusted formation pressure increase calculations, fluid front calculations and updated cross-sections of the confining and injection zones, based on the data obtained during construction and testing;

(G) the actual injection procedure;

(H) the compatibility of injected wastes with fluids in the injection zone and minerals in both the injection zone and the confining zone and materials used to construct the well;

(I) the calculated area of review and cone of influence based on data obtained during logging and testing of the well and the formation, and where necessary, revisions to the information submitted under '331.121 of this title (relating to Class I Wells);

(J) the status of corrective action required for defective wells in the area of review;

(K) a Well Data Report on forms provided by the executive director;

(L) compliance with the casing and cementing performance standard in '331.62(5) of this title; and

(M) compliance with the cementing requirements in ’331.62(6) of this title.

(2) Local authorities. The permittee shall provide written notice to the executive director, in a manner specified by the executive director, that a copy of the permit has been properly filed with the health and pollution control authorities of the county, city, and town where the well is located.

(3) Start-up date and time. The permittee shall notify the executive director in writing of the anticipated well start-up date. Compliance with all pre-operation terms of the permit must occur prior to beginning injection operations. The permittee shall notify the executive director at least 24 hours prior to beginning drilling operations.

(4) Approval of construction and completion. Prior to beginning operations, the permittee must obtain written approval from the executive director, according to ’331.45 of this title (relating to Executive Director Approval of Construction and Completion).

(b) Operating reports.

(1) Injection operation quarterly report. For non-commercial facilities only, within 20 days after the last day of the months of March, June, September, and December, the permittee shall submit to the executive director a quarterly report of injection operation on forms supplied by the executive director. These forms will comply with the reporting requirements of 40 Code of Federal Regulations (CFR) ’146.69(a). The executive director may require more frequent reporting.

(2) Injection operation monthly report. Commercial facilities shall meet the following requirements.

(A) The permittee shall submit within 30 days after the last day of each month a report to the commission including the following information for wastes received and injected during the month:

(i) names and locations of the companies and plants generating the wastes;
(ii) chemical and physical characteristics and volume of waste received from each company including pH;
(iii) names of companies transporting the wastes; and
(iv) a log of injection operations for each injection episode including but not limited to time of injection, injection rate, injection pressures, injection fluid volume, injection fluid pH, and injection fluid density.

(B) The permittee shall submit to the commission within 20 days of the last day of each month a report of injection operations on forms provided by the commission. These forms shall comply with the reporting requirements of 40 CFR ’146.69(a). The executive director may require more frequent reporting.

(3) Injection zone annual report. For all facilities, the permittee shall submit annually with the December report of injection operation an updated graphic or other acceptable report of the pressure effects of the well upon its injection zone as required by ’331.64(g) of this title (relating to Monitoring and Testing Requirements). To the extent this information is reasonably available, the report must also include:

(A) locations of newly constructed or newly discovered wells that penetrate the confining and/or injection zone within the area of review if those wells were not included in the technical report accompanying the permit application or in later reports;

(B) a tabulation of data as required by '331.121(2)(B) of this title for wells within the area of review that penetrate the injection zone or confining zone;

(C) the condition of the wells identified in subparagraph (A) of this paragraph and their effect on the injection activities;

(D) the protocol followed to identify, locate, and ascertain the condition of the wells identified in subparagraph (A) of this paragraph;

(E) a corrective action plan for wells not adequately constructed, completed, or plugged; and

(F) for non-commercial facilities only, a current injection fluid analysis.

(4) Mechanical integrity and other reports. The permittee shall submit within 30 days after test completion, a report including both data and interpretation on the results of:

(A) periodic tests of mechanical integrity; and

(B) any other test of the injection well or injection zone if required by the executive director.

(5) Emergency report of leak or other failure. The permittee shall notify the Underground Injection Control (UIC) Unit of the Austin office of the commission within 24 hours of any significant change in monitoring parameters or of any other observations which could reasonably be attributed to a leak or other failure of the well equipment or injection zone integrity.

(c) Workover reports. Within 30 days after the completion of the workover, a report shall be filed with the executive director including the reason for well workover and the details of all work performed.

'331.66. Additional Requirements and Conditions

(a) A permit for a Class I well shall include expressly or by reference the following conditions:

(1) A sign shall be posted at the well site which shall show the name of the company, company well number and commission permit number. The sign and identification shall be in the English language, clearly legible and shall be in numbers and letters at least one (1) inch high.

(2) An all-weather road shall be installed and maintained to allow access to the injection well and related facilities.

(3) The wellhead and associated facilities shall be painted, if appropriate, and maintained in good working order without leaks.

(4) The commission may prescribe additional requirements for Class I wells to protect USDWs, and fresh or surface water from pollution.

(b) Permit requirements for owners or operators of disposal wells which inject wastes which have the potential to react with the injection formation to generate gases shall include:

(1) conditions limiting the temperature, pH or acidity of the injected wastes; and

(2) procedures necessary to assure that pressure imbalances which might cause a backflow or blowout do not occur.

’331.67. Recordkeeping Requirements.

(a) The permittee shall keep complete and accurate records of:

(1) All monitoring required by the permit, including:

(A) continuous records of surface injection pressures,

(B) continuous records of the tubing-long string annulus pressures and volumes,

(C) continuous records of injection flow rates,

(D) monthly total volume of injected fluids.

(2) All periodic well tests, including but not limited to:

(A) injection fluid analyses,

(B) bottom hole pressure determinations,

(C) mechanical integrity, and

(D) casing inspection surveys.

(3) All shut-in periods and times that emergency measures were used for handling injection fluid.

(4) Any additional information on conditions that might reasonably affect the operation of the injection well.

(b) All records shall be made available for review upon request from a representative of the commission.

(c) The permittee shall retain, for a period of three years following the completion of any plugging and abandonment procedures, records of all monitoring information including the nature and composition of all injected fluids or other records required by the permit. The executive director may require a permittee to submit copies of the records at any time prior to conclusion of the retention period.

’331.68. Post-Closure Care

(a) The owner or operator of a Class I hazardous well shall prepare, maintain, and comply with a plan for post-closure care that meets the requirements of subsection (b) of this section, and is acceptable to the executive director. The obligation to implement the post-closure plan survives the termination of a permit or the cessation of injection activities. The requirement to maintain an approved plan is directly enforceable regardless of whether the requirement is a condition of the permit.

(1) The owner or operator shall submit the plan as a part of the permit application and, upon approval by the executive director, such plan shall be a condition of any permit issued.

(2) The owner or operator shall submit any proposed significant revision to the plan as appropriate over the life of the well, but no later than the date of the closure report required under ’331.46 of this title (relating to Closure Standards).

(3) The plan shall provide financial responsibility as required in Subchapter I of this chapter (relating to Financial Responsibility). The owner or operator shall demonstrate and maintain financial assurance in the amount of the post closure cost estimate to cover post-closure care in a manner that meets the requirements of Chapter 37, Subchapter Q of this title (relating to Financial Assurance for Underground Injection Wells). The amount of the funds available shall be no less than the amount identified in paragraph (4)(F) of this subsection. The obligation to maintain financial responsibility for post-closure care survives the termination of a permit or the cessation of injection.

(4) The plan shall include the following information:

(A) the pressure in the injection zone before injection began;

(B) the anticipated pressure in the injection zone at the time of closure;

(C) the predicted time until pressure in the injection zone decays to the point that the well’s cone of influence no longer intersects the base of the lowermost USDW or freshwater aquifer;

(D) predicted position of the waste front at closure;

(E) the status of any corrective action required under ’331.44 of this title (relating to Corrective Action Standards); and

(F) the estimated cost of proposed post-closure care.

(5) At the request of the owner or operator, or on his own initiative, the executive director may modify the post-closure plan after submission of the plugging and abandonment report following the procedures in ’305.72 of this title (relating to UIC Permit Modification at the Request of the Permittee).

(b) The owner or operator shall:

(1) continue and complete any corrective action required under ’331.44 of this title;

(2) continue to conduct any groundwater monitoring required under the permit until pressure in the injection zone decays to the point that the well's cone of influence no longer intersects the base of the lowermost USDW or freshwater aquifer. The executive director may extend the period of post-closure monitoring if he determines that the well may endanger a USDW or freshwater aquifer;

(3) submit a survey plat to the local zoning authority designated by the executive director. The plat shall indicate the location of the well relative to permanently surveyed benchmarks. A copy of the plat shall be submitted to the Underground Injection Control (UIC) program at the Austin office of the commission;

(4) Provide appropriate notification and information to such state and local authorities as have cognizance over drilling activities to enable such state and local authorities to impose appropriate conditions on subsequent drilling activities that may penetrate the well's confining or injection zone;

(5) Retain, for a period of three years following well closure, records reflecting the nature, composition, and volume of all injected fluids. The owner or operator must deliver the records to the executive director at the conclusion of the retention period, and the records shall thereafter be retained at a location designated by the executive director for that purpose.

SUBCHAPTER E: STANDARDS FOR CLASS III WELLS

Not Applicable

SUBCHAPTER F: STANDARDS FOR CLASS III WELL PRODUCTION AREA DEVELOPMENT

Not Applicable

SUBCHAPTER G: CONSIDERATION PRIOR TO PERMIT ISSUANCE

'331.120. Compliance History; Denial of Permit

Not Applicable

'331.121. Class I Wells

(a) The commission shall consider the following before issuing a Class I Injection Well Permit:

(1) all information in the completed application for permit;

(2) all information in the Technical Report submitted with the application for permit in accordance with '305.45(a)(8) of this title (relating to Contents of Application for Permit) including, but not limited to:

(A) a map showing the location of the injection well for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number, or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, mines (surface and subsurface), quarries, water wells, and other pertinent surface features, including residences and roads. The map should also show faults, if known or suspected. Only information of public record is required to be included on this map;

(B) a tabulation of all wells within the area of review which penetrate the injection zone or confining zone, and for salt cavern disposal wells, the salt cavern injection zone, salt cavern confining zone and caprock. Such data shall include a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the executive director may require;

(C) the protocol followed to identify, locate, and ascertain the condition of abandoned wells within the area of review which penetrate the injection or the confining zones;

(D) maps and cross-sections indicating the general vertical and lateral limits of underground sources of drinking water (USDWs) and freshwater aquifers, their positions relative to the injection formation and the direction of water movement, where known, in each USDW or freshwater aquifer which may be affected by the proposed injection;

(E) maps, cross-sections, and description of the geologic structure of the local area;

(F) maps, cross-sections, and description of the regional geologic setting;

(G) proposed operating data:

(i) average and maximum daily injection rate and volume of the fluid or waste to be injected over the anticipated life of the injection well;
(ii) average and maximum injection pressure;
(iii) source of the waste streams;
(iv) an analysis of the chemical and physical characteristics of the waste streams;
(v) for salt cavern waste disposal, the bulk waste density, permeability, porosity, and compaction rate, as well as the individual physical characteristics of the wastes and transporting media;
(vi) for salt cavern waste disposal, the results of tests performed on the waste to demonstrate that the waste will remain solid under cavern conditions; and
(vii) any additional analyses which the executive director may reasonably require;

(H) proposed formation testing program to obtain an analysis of the chemical, physical, and radiological characteristics of formation fluids, and other information on the injection zone and confining zone;

(I) proposed stimulation program, if needed;

(J) proposed operation and injection procedures;

(K) engineering drawings of the surface and subsurface construction details of the injection well and pre-injection units, except that pre-injection units registered under the provisions of '331.17 of this title (relating to Pre-Injection Units Registration) shall be considered under that section;

(L) contingency plans, based on a reasonable worst case scenario, to cope with all shut-ins; loss of cavern integrity, or well failures so as to prevent migration of fluid into any USDW;

(M) plans (including maps) for meeting the monitoring requirements of this chapter, such plans shall include all parameters, test methods, sample methods, and quality assurance procedures necessary and used to meet these requirements;

(N) for wells within the area of review which penetrate the injection zone or confining zone but are not adequately constructed, completed, or plugged, the corrective action proposed to be taken;

(O) construction procedures including a cementing and casing program, contingency cementing plan for managing lost circulation zones and other adverse subsurface conditions, well materials specifications and their life expectancy, logging procedures, deviation checks, and a drilling, testing, and coring program;

(P) delineation of all faults within the area of review, together with a demonstration, unless previously demonstrated to the commission or to the United States Environmental Protection Agency, that the fault is not sufficiently transmissive or vertically extensive to allow migration of hazardous constituents out of the injection zone;

(Q) the authorization status under this chapter of the pre-injection units for the injection well; and

(R) information demonstrating compliance with the applicable design criteria of Chapter 317 of this title (relating to Design Criteria for Sewerage Systems), for pre-injection units associated with Class I nonhazardous, noncommercial injection wells.

(3) whether the applicant will assure, in accordance with Chapter 37, Subchapter Q of this title (relating to Financial Assurance for Underground Injection Control Wells), the resources necessary to close, plug, abandon, and if applicable, provide post-closure care for the well and/or waste disposal cavern as required;

(4) the closure plan, corrective action plan, and post-closure plan submitted in the technical report accompanying the permit application;

(5) any additional information required by the executive director for the evaluation of the proposed injection well.

(b) In determining whether the use or installation of an injection well is in the public interest under Texas Water Code, '27.051(a)(1), the commission shall also consider:

(1) the compliance history of the applicant in accordance with Texas Water Code, '27.051(e) and '281.21(d) of this title (relating to Draft Permit, Technical Summary, Fact Sheet, and Compliance Summary);

(2) whether there is a practical, economic and feasible alternative to an injection well reasonably available to manage the types and classes of hazardous waste;

(3) if the injection well will be used for the disposal of hazardous waste, whether the applicant will maintain liability coverage for bodily injury and property damage to third parties that is caused by sudden and nonsudden accidents in accordance with Chapter 37 of this title (relating to Financial Assurance); and

(4) that any permit issued for a Class I injection well for disposal of hazardous wastes generated on site requires a certification by the owner or operator that:

(A) the generator of the waste has a program to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to economically practicable; and

(B) injection of the waste is that practicable method of disposal currently available to the generator which minimizes the present and future threat to human health and the environment.

(c) The commission shall consider the following minimum criteria for siting before issuing a Class I injection well permit.

(1) All Class I injection wells shall be sited such that they inject into a formation that is beneath the lowermost formation containing, within 1/4 mile of the wellbore, a USDW or freshwater aquifer.

(2) The siting of Class I injection wells shall be limited to areas that are geologically suitable. The executive director shall determine geologic suitability based upon:

(A) an analysis of the structural and stratigraphic geology, the hydrogeology, and the seismicity of the region;

(B) an analysis of the local geology and hydrogeology of the well site, including, at a minimum, detailed information regarding stratigraphy, structure, and rock properties, aquifer hydrodynamics, and mineral resources; and

(C) a determination that the geology of the area can be described confidently and that limits of waste fate and transport can be accurately predicted through the use of analytical and numerical models.

(3) Class I injection wells shall be sited such that:

(A) the injection zone has sufficient permeability, porosity, thickness, and areal extent to prevent migration of fluids into USDWs or freshwater aquifers;

(B) the confining zone:

(i) is laterally continuous and free of transecting, transmissive faults or fractures over an area sufficient to prevent the movement of fluids into a USDW or freshwater aquifer; and
(ii) contains at least one formation of sufficient thickness and with lithologic and stress characteristics capable of preventing initiation and/or propagation of fractures.

(4) The owner or operator shall demonstrate to the satisfaction of the executive director that:

(A) the confining zone is separated from the base of the lowermost USDW or freshwater aquifer by at least one sequence of permeable and less permeable strata that will provide an added layer of protection for the USDW or freshwater aquifer in the event of fluid movement in an unlocated borehole or transmissive fault; or

(B) within the area of review, the piezometric surface of the fluid in the injection zone is less than the piezometric surface of the lowermost USDW or freshwater aquifer, considering density effects, injection pressures, and any significant pumping in the overlying USDW or freshwater aquifer; or

(C) there is no USDW or freshwater aquifer present;

(D) the commission may approve a site which does not meet the requirements in subparagraphs (A), (B), or (C) of this paragraph if the owner or operator can demonstrate to the commission that because of the geology, nature of the waste, or other considerations, that abandoned boreholes or other conduits would not cause endangerment of USDWs, and fresh or surface water.

(d) The commission shall also consider the following additional information, which must be submitted in the technical report of the application as part of demonstrating that the facility will meet the performance standard in '331.162 of this title (relating to Performance Standard), before issuing a salt cavern Class I injection well permit:

(1) a thorough characterization of the salt dome to establish the geologic suitability of the location, including:

(A) data and interpretation from all appropriate geophysical methods (such as well logs, seismic surveys, and gravity surveys), subject to the approval of the executive director, necessary to:

(i) map the overall geometry of the salt dome, including all edges and any suspected overhangs of the salt stock;
(ii) demonstrate the existence of a minimum distance of 500 feet between the boundaries of the proposed salt cavern injection zone and the boundaries of the salt stock;
(iii) define the composition and map the top and thickness of the sedimentary rock units between the caprock and surface, including the flanks of the salt stock;
(iv) define the composition and map the top and thickness of the caprock overlying the salt stock;
(v) map the top of the salt stock;
(vi) calculate the movement and the salt loss rate of the salt stock;
(vii) define any other caverns and other uses of the salt dome, and address any conditions that may result in potential adverse impact on the salt dome; and
(viii) satisfy any other requirement of the executive director necessary to demonstrate the geologic suitability of the location;

(B) a surface-recorded three-dimensional seismic survey, subject to the following minimum requirements:

(i) the lateral extent of the survey will be determined by the executive director; and

(ii) the survey must provide information as part of demonstrating that the location is geologically suitable for the purpose of meeting the performance standard in '331.162 of this title;

(C) identification of any unusual features, such as depressions or lineations observable at the land surface or within or detectable within the subsurface, which may be indicative of underlying anomalies in the caprock or salt stock, which might affect construction, operation, or closure of the cavern;

(D) the petrology of the caprock, salt stock, and deformed strata; and

(E) for strata surrounding the salt stock, information on their nature, structure, hydrodynamic properties, and relationships to USDWs, including a demonstration that the proposed salt cavern injection zone will not be in or above a formation which within 1/4 mile of the salt cavern injection zone contains a USDW;

(2) establishment of a pre-development baseline for subsidence and groundwater monitoring, over the area of review;

(3) characterization of the predicted impact of the proposed operations on the salt stock, specifically the extent of the disturbed zone;

(4) demonstration of adequate separation between the outer limits of the injection zone and any other activities in the domal area. The thickness of the disturbed zone, as well as any additional safety factors will be taken into consideration; and

(5) the commission will consider the presence of salt cavern storage activities, sulfur mining, salt mining, brine production, oil and gas activity, and any other activity which may adversely affect or be affected by waste disposal in a salt cavern.

(e) Information requirements for Class I hazardous waste injection well permits.

(1) The following information is required for each active Class I hazardous waste injection well at a facility seeking an underground injection control permit:

(A) dates well was operated; and

(B) pecification of all wastes that have been injected in the well, if available.

(2) The owner or operator of any facility containing one or more active hazardous waste injection wells must submit all available information pertaining to any release of hazardous waste or constituents from any active hazardous waste injection well at the facility.

(3) The owner or operator of any facility containing one or more active Class I hazardous waste injection wells must conduct such preliminary site investigations as are necessary to determine whether a release is occurring, has occurred, or is likely to have occurred.

(f) Interim Status under the RCRA for Class I hazardous waste injection wells. The minimum state standards which define acceptable injection of hazardous waste during the period of interim status are set out in this chapter. The issuance of an underground injection well permit does not automatically terminate RCRA interim status. A Class I well's interim status does, however, automatically terminate upon issuance of a RCRA permit for that well, or upon the well's receiving a RCRA permit-by-rule under '335.47 of this title (relating to Special Requirements for Persons Eligible for a Federal Permit by Rule). Thus, until a Class I well injecting hazardous waste receives a RCRA permit or RCRA permit-by-rule, the well's interim status requirements are the applicable requirements imposed under this chapter, including any requirements imposed in the UIC permit.

(g) Before issuing a permit for a hazardous waste injection well in a solution-mined salt dome cavern, the commission by order must find that there is an urgent public necessity for the hazardous waste injection well. The commission, in determining whether an urgent public necessity exists for the permitting of the hazardous waste injection well in a solution-mined salt dome cavern, must find that:

(1) the injection well will be designed, constructed, and operated in a manner that provides at least the same degree of safety as required of other currently operating hazardous waste disposal technologies;

(2) consistent with the need and desire to manage the state hazardous wastes generated in the state, there is a substantial or obvious public need for additional hazardous waste disposal capacity and the hazardous waste injection well will contribute additional capacity toward servicing that need;

(3) that the injection well will be constructed and operated in a manner so as to safeguard public health and welfare and protect physical property and the environment;

(4) the applicant has demonstrated that groundwater and surface waters, including public water supplies, will be protected from the release of hazardous waste from the salt dome waste containment cavern; and

(5) any other criteria required by the commission to satisfy that the test of urgency has been met.

'331.122. Class III Wells

Not Applicable

SUBCHAPTER H: STANDARDS FOR CLASS V WELLS

'331.131. Applicability

The sections of this subchapter apply to all Class V injection wells under the jurisdiction of the commission. Aquifer storage wells must also comply with Subchapter K of this chapter (relating to Additional Requirements for Class V Aquifer Storage Wells) in addition to this subchapter.

'331.132. Construction Standards

(a) All Class V wells shall be completed in accordance with the specifications contained in this section, unless otherwise authorized by the executive director. Injection wells listed in Texas Water Code, '32.001(8) shall be installed by a water well driller licensed by the Texas Department of Licensing and Regulation.

(b) Reporting

(1) Prior to construction. Except for closed loop injection and air conditioning return flow wells, information required under ’331.10(a) of this title (relating to Inventory of Wells Authorized by Rule) shall be submitted to the executive director for review and approval prior to construction. For large capacity septic systems the information required under ’331.10(a) of this title shall be submitted as part of the wastewater discharge permit application filed under Chapter 305 of this title (relating to Consolidated Permits).

(2) After completion of construction. Except for large capacity septic systems, subsurface fluid distribution systems, temporary injection points, closed loop injection wells, improved sinkholes, and air conditioning return flow wells, the Texas Department of Licensing and Regulation state well report form shall be submitted to the executive director within 30 days from the date the well construction is completed.

(3) Closed loop and air conditioning return flow wells. No reporting prior to construction is necessary for these two types of wells. The Texas Department of Licensing and Regulation state well report form shall be completed and submitted to the executive director within 30 days from the date the well construction is completed. Any additives, constituents, or fluids (other than potable water) that are used in the closed loop injection well system shall be reported in the Water Quality Section on the state well report form.

(4) Temporary injection points. Temporary injection points shall be completed in such a manner as to prevent movement of surface water or undesirable groundwater into underground sources of drinking water (USDW).

(5) Large capacity septic systems, subsurface fluid distribution systems, and improved sinkholes. The owner or operator of large capacity septic systems, subsurface fluid distribution systems, and improved sinkholes must submit the well report form provided by the executive director within 30 days from the date well construction is completed.

(c) Sealing of casing

(1) General. Except for closed loop injection wells, the annular space between the borehole and the casing shall be filled with cement slurry from ground level to a depth of not less than ten feet below the land surface or well head. In areas of shallow, unconfined groundwater aquifers, the cement need not be placed below the static water level. In areas of shallow, confined groundwater aquifers having artesian head, the cement need not be placed below the top of the water-bearing strata.

(2) Closed loop injection well. The annular space of a closed loop injection well shall be backfilled to the total depth with impervious bentonite or a similar material. Where no groundwater or only one zone of groundwater is encountered, sand, gravel, or drill cuttings may be used to backfill up to 30 feet from the surface. The top 30 feet shall be filled with impervious bentonite. Alternative impervious materials may be authorized by the executive director upon request.

(d) Surface completion

(1) With the exception of temporary injection points, subsurface fluid distribution systems, improved sinkholes, and large capacity septic systems, all wells must have a concrete slab or sealing block placed above the cement slurry around the well at the ground surface.

(A) The slab or block shall extend at least two feet from the well in all directions and have a minimum thickness of four inches and shall be separated from the well casing by a plastic or mastic coating or sleeve to prevent bonding of the slab to the casing.

(B) The surface of the slab shall be sloped so that liquid will drain away from the well.

(2) For wells that use casing, the top of the casing shall extend a minimum of 12 inches above the original ground surface. The well casing shall be capped or completed in a manner that will prevent pollutants from entering the well.

(3) Closed loop injection wells which are completed below grade are exempt from the surface completion standards in this subsection. Pitless adapters may be used in close loop wells provided that:

(A) the adapter is welded to the casing or fitted with another suitably effective seal; and

(B) the annular space between the borehole and the casing is filled with cement to a depth not less than 15 feet below the adapter connection.

(4) Temporary injection points shall be completed in such a manner as to prevent the movement of surface water or undesirable groundwater into a USDW.

(e) Optional use of a steel or PVC sleeve. If the use of a steel or PVC sleeve is necessary to prevent possible damage to the casing, the steel sleeve shall be a minimum of 3/16 inches in thickness or the PVC sleeve shall be a minimum of Schedule 80 sun-resistant and 24 inches in length, and shall extend 12 inches into the cement slurry.

(f) Well placement in a flood-prone area. All wells shall be located in areas not generally subject to flooding. If a well must be placed in a flood-prone area, it shall be completed with a watertight sanitary well seal to maintain a junction between the casing and injection tubing, and a steel sleeve extending a minimum of 36 inches above ground level and 24 inches below the ground surface shall be used. For the purpose of this subsection, a flood-prone area is defined as that area within the 100-year flood plain as determined on the Federal Emergency Management Agency (FEMA) Flood Hazard Maps for the National Flood Insurance Program. If FEMA has conducted a flood insurance study of the area, and has mapped the 50-year flood plain, then the smaller geographic areas within the 50-year boundary are considered to be flood-prone. Closed loop injection wells, improved sinkholes, and air conditioning return flow wells are exempt from the completion standards in this subsection.

(g) Other protection measures

(1) Commingling prohibited. All wells, especially those that are gravel packed, shall be completed so that aquifers or zones containing waters that are known to differ significantly in chemical quality are not allowed to commingle through the borehole-casing annulus or the gravel pack and cause quality degradation of any aquifer containing fresh water.

(2) Undesirable groundwater. When undesirable groundwater, which is water that is injurious to human health and the environment or water that can cause pollution to land or other waters, is encountered in a Class V well, the well shall be constructed so that the undesirable groundwater is isolated from any underground source of drinking water and is confined to the zone(s) of origin.

(h) Sampling. For a Class V injection well, any required sampling shall be done at the point of injection, or as specified in a permit issued by the executive director.

’331.133. Closure Standards for Injection Wells

(a) It is the responsibility of the owner or operator to close a Class V well which is to be permanently discontinued or abandoned under standards set forth in this section unless the well must comply with ’331.136 of this title (relating to Closure Standards for Motor Vehicle Waste Disposal Wells, Large Capacity Septic Systems, Large Capacity Cesspools, Subsurface Fluid Distribution Systems, and Drywells). The well must be closed in a manner that complies with ’331.5 of this title (relating to Prevention of Pollution) and 40 Code of Federal Regulations (CFR) ’144.12 (A prohibition of movement of fluid into underground sources of drinking water, effective June 2, 1987 at 48 FR 20676). Any contaminated soil, gravel, sludge, liquids, or other materials removed from or adjacent to the well must be managed in accordance with Chapter 350 of this title (relating to Texas Risk Reduction Program), and all other applicable federal, state, and local regulations and requirements.

(b) Closure shall be accomplished by removing all the removable casing, and the entire well shall be pressure filled via a tremie pipe with cement from bottom to the land surface.

(c) As an alternative to the procedure in subsection (b) of this section, if a Class V well is not completed through zones containing undesirable groundwater, water that is injurious to human health and the environment or water that can cause pollution to land or other waters, the well may be filled with fine sand, clay, or heavy mud followed by a cement plug extending from land surface to a depth of not less than ten feet below the land surface.

(d) As an alternative to the procedure in subsection (b) of this section, if a Class V well is completed through zones containing undesirable groundwater, water that is injurious to human health and the environment or water that can cause pollution to land or other waters, either the zone(s) containing undesirable groundwater or the fresh groundwater zone(s) shall be isolated with cement plugs and the remainder of the wellbore filled with bentonite grout (9.1 pounds per gallon mud or more) followed by a cement plug extending from land surface to a depth of not less than ten feet below the land surface.

(e) It is the responsibility of the owner or operator to ensure that temporary injection points are pressure grouted from the bottom of the well to the land surface, and the injection point is sealed to prevent the migration of fluids into underground sources of drinking water.

(f) It is the responsibility of the owner or operator to close improved sinkholes in a manner that prohibits the movement of contaminated fluids into underground sources of drinking water, in compliance with ’331.5 of this title, and 40 CFR ’144.12 (as amended through June 2, 1987 at 48 FR 20676); and to demonstrate that any fluids released through the closed well will meet the primary maximum contaminant levels (MCLs) for drinking water contained in 40 CFR Part 141, and other appropriate health-based standards at the point of injection.

’331.135. Construction Standards for Large Capacity Septic Systems

Not Applicable

'331.136. Closure Standards for Motor Vehicle Waste Disposal Wells, Large Capacity Septic Systems, Large Capacity Cesspools, Subsurface Fluid Distribution Systems, and Drywells

Not Applicable

'331.137. Permit for Motor Vehicle Waste Disposal Wells

Not Applicable

SUBCHAPTER G: CONSIDERATION PRIOR TO PERMIT ISSUANCE

'331.120. Compliance History; Denial of Permit

Not Applicable

'331.121. Class I Wells

(a) The commission shall consider the following before issuing a Class I Injection Well Permit:

(1) all information in the completed application for permit;

(2) all information in the Technical Report submitted with the application for permit in accordance with '305.45(a)(8) of this title (relating to Contents of Application for Permit) including, but not limited to:

(A) a map showing the location of the injection well for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number, or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, mines (surface and subsurface), quarries, water wells, and other pertinent surface features, including residences and roads. The map should also show faults, if known or suspected. Only information of public record is required to be included on this map;

(B) a tabulation of all wells within the area of review which penetrate the injection zone or confining zone, and for salt cavern disposal wells, the salt cavern injection zone, salt cavern confining zone and caprock. Such data shall include a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the executive director may require;

(C) the protocol followed to identify, locate, and ascertain the condition of abandoned wells within the area of review which penetrate the injection or the confining zones;

(D) maps and cross-sections indicating the general vertical and lateral limits of underground sources of drinking water (USDWs) and freshwater aquifers, their positions relative to the injection formation and the direction of water movement, where known, in each USDW or freshwater aquifer which may be affected by the proposed injection;

(E) maps, cross-sections, and description of the geologic structure of the local area;

(F) maps, cross-sections, and description of the regional geologic setting;

(G) proposed operating data:

(i) average and maximum daily injection rate and volume of the fluid or waste to be injected over the anticipated life of the injection well;
(ii) average and maximum injection pressure;
(iii) source of the waste streams;
(iv) an analysis of the chemical and physical characteristics of the waste streams;
(v) for salt cavern waste disposal, the bulk waste density, permeability, porosity, and compaction rate, as well as the individual physical characteristics of the wastes and transporting media;
(vi) for salt cavern waste disposal, the results of tests performed on the waste to demonstrate that the waste will remain solid under cavern conditions; and
(vii) any additional analyses which the executive director may reasonably require;

(H) proposed formation testing program to obtain an analysis of the chemical, physical, and radiological characteristics of formation fluids, and other information on the injection zone and confining zone;

(I) proposed stimulation program, if needed;

(J) proposed operation and injection procedures;

(K) engineering drawings of the surface and subsurface construction details of the injection well and pre-injection units, except that pre-injection units registered under the provisions of '331.17 of this title (relating to Pre-Injection Units Registration) shall be considered under that section;

(L) contingency plans, based on a reasonable worst case scenario, to cope with all shut-ins; loss of cavern integrity, or well failures so as to prevent migration of fluid into any USDW;

(M) plans (including maps) for meeting the monitoring requirements of this chapter, such plans shall include all parameters, test methods, sample methods, and quality assurance procedures necessary and used to meet these requirements;

(N) for wells within the area of review which penetrate the injection zone or confining zone but are not adequately constructed, completed, or plugged, the corrective action proposed to be taken;

(O) construction procedures including a cementing and casing program, contingency cementing plan for managing lost circulation zones and other adverse subsurface conditions, well materials specifications and their life expectancy, logging procedures, deviation checks, and a drilling, testing, and coring program;

(P) delineation of all faults within the area of review, together with a demonstration, unless previously demonstrated to the commission or to the United States Environmental Protection Agency, that the fault is not sufficiently transmissive or vertically extensive to allow migration of hazardous constituents out of the injection zone;

(Q) the authorization status under this chapter of the pre-injection units for the injection well; and

(R) information demonstrating compliance with the applicable design criteria of Chapter 317 of this title (relating to Design Criteria for Sewerage Systems), for pre-injection units associated with Class I nonhazardous, noncommercial injection wells.

(3) whether the applicant will assure, in accordance with Chapter 37, Subchapter Q of this title (relating to Financial Assurance for Underground Injection Control Wells), the resources necessary to close, plug, abandon, and if applicable, provide post-closure care for the well and/or waste disposal cavern as required;

(4) the closure plan, corrective action plan, and post-closure plan submitted in the technical report accompanying the permit application;

(5) any additional information required by the executive director for the evaluation of the proposed injection well.

(b) In determining whether the use or installation of an injection well is in the public interest under Texas Water Code, ’27.051(a)(1), the commission shall also consider:

(1) the compliance history of the applicant in accordance with Texas Water Code, ’27.051(e) and ’281.21(d) of this title (relating to Draft Permit, Technical Summary, Fact Sheet, and Compliance Summary);

(2) whether there is a practical, economic and feasible alternative to an injection well reasonably available to manage the types and classes of hazardous waste;

(3) if the injection well will be used for the disposal of hazardous waste, whether the applicant will maintain liability coverage for bodily injury and property damage to third parties that is caused by sudden and nonsudden accidents in accordance with Chapter 37 of this title (relating to Financial Assurance); and

(4) that any permit issued for a Class I injection well for disposal of hazardous wastes generated on site requires a certification by the owner or operator that:

(A) the generator of the waste has a program to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to economically practicable; and

(B) injection of the waste is that practicable method of disposal currently available to the generator which minimizes the present and future threat to human health and the environment.

(c) The commission shall consider the following minimum criteria for siting before issuing a Class I injection well permit.

(1) All Class I injection wells shall be sited such that they inject into a formation that is beneath the lowermost formation containing, within 1/4 mile of the wellbore, a USDW or freshwater aquifer.

(2) The siting of Class I injection wells shall be limited to areas that are geologically suitable. The executive director shall determine geologic suitability based upon:

(A) an analysis of the structural and stratigraphic geology, the hydrogeology, and the seismicity of the region;

(B) an analysis of the local geology and hydrogeology of the well site, including, at a minimum, detailed information regarding stratigraphy, structure, and rock properties, aquifer hydrodynamics, and mineral resources; and

(C) a determination that the geology of the area can be described confidently and that limits of waste fate and transport can be accurately predicted through the use of analytical and numerical models.

(3) Class I injection wells shall be sited such that:

(A) the injection zone has sufficient permeability, porosity, thickness, and a real extent to prevent migration of fluids into USDWs or freshwater aquifers;

(B) the confining zone:

(i) is laterally continuous and free of transecting, transmissive faults or fractures over an area sufficient to prevent the movement of fluids into a USDW or freshwater aquifer; and
(ii) contains at least one formation of sufficient thickness and with lithologic and stress characteristics capable of preventing initiation and/or propagation of fractures.

(4) The owner or operator shall demonstrate to the satisfaction of the executive director that:

(A) the confining zone is separated from the base of the lowermost USDW or freshwater aquifer by at least one sequence of permeable and less permeable strata that will provide an added layer of protection for the USDW or freshwater aquifer in the event of fluid movement in an unlocated borehole or transmissive fault; or

(B) within the area of review, the piezometric surface of the fluid in the injection zone is less than the piezometric surface of the lowermost USDW or freshwater aquifer, considering density effects, injection pressures, and any significant pumping in the overlying USDW or freshwater aquifer; or

(C) there is no USDW or freshwater aquifer present;

(D) the commission may approve a site which does not meet the requirements in subparagraphs (A), (B), or (C) of this paragraph if the owner or operator can demonstrate to the commission that because of the geology, nature of the waste, or other considerations, that abandoned boreholes or other conduits would not cause endangerment of USDWs, and fresh or surface water.

(d) The commission shall also consider the following additional information, which must be submitted in the technical report of the application as part of demonstrating that the facility will meet the performance standard in '331.162 of this title (relating to Performance Standard), before issuing a salt cavern Class I injection well permit:

(1) a thorough characterization of the salt dome to establish the geologic suitability of the location, including:

(A) data and interpretation from all appropriate geophysical methods (such as well logs, seismic surveys, and gravity surveys), subject to the approval of the executive director, necessary to:

(i) map the overall geometry of the salt dome, including all edges and any suspected overhangs of the salt stock;
(ii) demonstrate the existence of a minimum distance of 500 feet between the boundaries of the proposed salt cavern injection zone and the boundaries of the salt stock;
(iii) define the composition and map the top and thickness of the sedimentary rock units between the caprock and surface, including the flanks of the salt stock;
(iv) define the composition and map the top and thickness of the caprock overlying the salt stock;
(v) map the top of the salt stock;
(vi) calculate the movement and the salt loss rate of the salt stock;
(vii) define any other caverns and other uses of the salt dome, and address any conditions that may result in potential adverse impact on the salt dome; and
(viii) satisfy any other requirement of the executive director necessary to demonstrate the geologic suitability of the location;

(B) a surface-recorded three-dimensional seismic survey, subject to the following minimum requirements:

(i) the lateral extent of the survey will be determined by the executive director; and
(ii) the survey must provide information as part of demonstrating that the location is geologically suitable for the purpose of meeting the performance standard in ’331.162 of this title;

(C) identification of any unusual features, such as depressions or lineations observable at the land surface or within or detectable within the subsurface, which may be indicative of underlying anomalies in the caprock or salt stock, which might affect construction, operation, or closure of the cavern;

(D) the petrology of the caprock, salt stock, and deformed strata; and

(E) for strata surrounding the salt stock, information on their nature, structure, hydrodynamic properties, and relationships to USDWs, including a demonstration that the proposed salt cavern injection zone will not be in or above a formation which within 1/4 mile of the salt cavern injection zone contains a USDW;

(2) establishment of a pre-development baseline for subsidence and groundwater monitoring, over the area of review;

(3) characterization of the predicted impact of the proposed operations on the salt stock, specifically the extent of the disturbed zone;

(4) demonstration of adequate separation between the outer limits of the injection zone and any other activities in the domal area. The thickness of the disturbed zone, as well as any additional safety factors will be taken into consideration; and

(5) the commission will consider the presence of salt cavern storage activities, sulfur mining, salt mining, brine production, oil and gas activity, and any other activity which may adversely affect or be affected by waste disposal in a salt cavern.

(e) Information requirements for Class I hazardous waste injection well permits.

(1) The following information is required for each active Class I hazardous waste injection well at a facility seeking an underground injection control permit:

(A) dates well was operated; and

(B) specification of all wastes that have been injected in the well, if available.

(2) The owner or operator of any facility containing one or more active hazardous waste injection wells must submit all available information pertaining to any release of hazardous waste or constituents from any active hazardous waste injection well at the facility.

(3) The owner or operator of any facility containing one or more active Class I hazardous waste injection wells must conduct such preliminary site investigations as are necessary to determine whether a release is occurring, has occurred, or is likely to have occurred.

(f) Interim Status under the RCRA for Class I hazardous waste injection wells. The minimum state standards which define acceptable injection of hazardous waste during the period of interim status are set out in this chapter. The issuance of an underground injection well permit does not automatically terminate RCRA interim status. A Class I well's interim status does, however, automatically terminate upon issuance of a RCRA permit for that well, or upon the well's receiving a RCRA permit-by-rule under '335.47 of this title (relating to Special Requirements for Persons Eligible for a Federal Permit by Rule). Thus, until a Class I well injecting hazardous waste receives a RCRA permit or RCRA permit-by-rule, the well's interim status requirements are the applicable requirements imposed under this chapter, including any requirements imposed in the UIC permit.

(g) Before issuing a permit for a hazardous waste injection well in a solution-mined salt dome cavern, the commission by order must find that there is an urgent public necessity for the hazardous waste injection well. The commission, in determining whether an urgent public necessity exists for the permitting of the hazardous waste injection well in a solution-mined salt dome cavern, must find that:

(1) the injection well will be designed, constructed, and operated in a manner that provides at least the same degree of safety as required of other currently operating hazardous waste disposal technologies;

(2) consistent with the need and desire to manage the state hazardous wastes generated in the state, there is a substantial or obvious public need for additional hazardous waste disposal capacity and the hazardous waste injection well will contribute additional capacity toward servicing that need;

(3) that the injection well will be constructed and operated in a manner so as to safeguard public health and welfare and protect physical property and the environment;

(4) the applicant has demonstrated that groundwater and surface waters, including public water supplies, will be protected from the release of hazardous waste from the salt dome waste containment cavern; and

(5) any other criteria required by the commission to satisfy that the test of urgency has been met.

'331.122. Class III Wells.

Not Applicable

SUBCHAPTER H: STANDARDS FOR CLASS V WELLS

'331.131. Applicability

The sections of this subchapter apply to all Class V injection wells under the jurisdiction of the commission. Aquifer storage wells must also comply with Subchapter K of this chapter (relating to Additional Requirements for Class V Aquifer Storage Wells) in addition to this subchapter.

'331.132. Construction Standards

(a) All Class V wells shall be completed in accordance with the specifications contained in this section, unless otherwise authorized by the executive director. Injection wells listed in Texas Water Code, '32.001(8) shall be installed by a water well driller licensed by the Texas Department of Licensing and Regulation.

(b) Reporting

(1) Prior to construction. Except for closed loop injection and air conditioning return flow wells, information required under '331.10(a) of this title (relating to Inventory of Wells Authorized by Rule) shall be submitted to the executive director for review and approval prior to construction. For large capacity septic systems the information required under '331.10(a) of this title shall be submitted as part of the wastewater discharge permit application filed under Chapter 305 of this title (relating to Consolidated Permits).

(2) After completion of construction. Except for large capacity septic systems, subsurface fluid distribution systems, temporary injection points, closed loop injection wells, improved sinkholes, and air conditioning return flow wells, the Texas Department of Licensing and Regulation state well report form shall be submitted to the executive director within 30 days from the date the well construction is completed.

(3) Closed loop and air conditioning return flow wells. No reporting prior to construction is necessary for these two types of wells. The Texas Department of Licensing and Regulation state well report form shall be completed and submitted to the executive director within 30 days from the date the well construction is completed. Any additives, constituents, or fluids (other than potable water) that are used in the closed loop injection well system shall be reported in the Water Quality Section on the state well report form.

(4) Temporary injection points. Temporary injection points shall be completed in such a manner as to prevent movement of surface water or undesirable groundwater into USDW.

(5) Large capacity septic systems, subsurface fluid distribution systems, and improved sinkholes. The owner or operator of large capacity septic systems, subsurface fluid

distribution systems, and improved sinkholes must submit the well report form provided by the executive director within 30 days from the date well construction is completed.

(c) Sealing of casing

(1) General. Except for closed loop injection wells, the annular space between the borehole and the casing shall be filled with cement slurry from ground level to a depth of not less than ten feet below the land surface or well head. In areas of shallow, unconfined groundwater aquifers, the cement need not be placed below the static water level. In areas of shallow, confined groundwater aquifers having artesian head, the cement need not be placed below the top of the water-bearing strata.

(2) Closed loop injection well. The annular space of a closed loop injection well shall be backfilled to the total depth with impervious bentonite or a similar material. Where no groundwater or only one zone of groundwater is encountered, sand, gravel, or drill cuttings may be used to backfill up to 30 feet from the surface. The top 30 feet shall be filled with impervious bentonite. Alternative impervious materials may be authorized by the executive director upon request.

(d) Surface completion

(1) With the exception of temporary injection points, subsurface fluid distribution systems, improved sinkholes, and large capacity septic systems, all wells must have a concrete slab or sealing block placed above the cement slurry around the well at the ground surface.

(A) The slab or block shall extend at least two feet from the well in all directions and have a minimum thickness of four inches and shall be separated from the well casing by a plastic or mastic coating or sleeve to prevent bonding of the slab to the casing.

(B) The surface of the slab shall be sloped so that liquid will drain away from the well.

(2) For wells that use casing, the top of the casing shall extend a minimum of 12 inches above the original ground surface. The well casing shall be capped or completed in a manner that will prevent pollutants from entering the well.

(3) Closed loop injection wells which are completed below grade are exempt from the surface completion standards in this subsection. Pitless adapters may be used in close loop wells provided that:

(A) the adapter is welded to the casing or fitted with another suitably effective seal; and

(B) the annular space between the borehole and the casing is filled with cement to a depth not less than 15 feet below the adapter connection.

(4) Temporary injection points shall be completed in such a manner as to prevent the movement of surface water or undesirable groundwater into a USDW.

(e) Optional use of a steel or PVC sleeve. If the use of a steel or PVC sleeve is necessary to prevent possible damage to the casing, the steel sleeve shall be a minimum of 3/16 inches in thickness or the PVC sleeve shall be a minimum of Schedule 80 sun-resistant and 24 inches in length, and shall extend 12 inches into the cement slurry.

(f) Well placement in a flood-prone area. All wells shall be located in areas not generally subject to flooding. If a well must be placed in a flood-prone area, it shall be completed with a watertight sanitary well seal to maintain a junction between the casing and injection tubing, and a steel sleeve extending a minimum of 36 inches above ground level and 24 inches below the ground surface shall be used. For the purpose of this subsection, a flood-prone area is defined as that area within the 100-year flood plain as determined on the Federal Emergency Management Agency (FEMA) Flood Hazard Maps for the National Flood Insurance Program. If FEMA has conducted a flood insurance study of the area, and has mapped the 50-year flood plain, then the smaller geographic areas within the 50-year boundary are considered to be flood-prone. Closed loop injection wells, improved sinkholes, and air conditioning return flow wells are exempt from the completion standards in this subsection.

(g) Other protection measures

(1) Commingling prohibited. All wells, especially those that are gravel packed, shall be completed so that aquifers or zones containing waters that are known to differ significantly in chemical quality are not allowed to commingle through the borehole-casing annulus or the gravel pack and cause quality degradation of any aquifer containing fresh water.

(2) Undesirable groundwater. When undesirable groundwater, which is water that is injurious to human health and the environment or water that can cause pollution to land or other waters, is encountered in a Class V well, the well shall be constructed so that the undesirable groundwater is isolated from any underground source of drinking water and is confined to the zone(s) of origin.

(h) Sampling. For a Class V injection well, any required sampling shall be done at the point of injection, or as specified in a permit issued by the executive director.

’331.133. Closure Standards for Injection Wells

(a) It is the responsibility of the owner or operator to close a Class V well which is to be permanently discontinued or abandoned under standards set forth in this section unless the well must comply with ’331.136 of this title (relating to Closure Standards for Motor Vehicle Waste Disposal Wells, Large Capacity Septic Systems, Large Capacity Cesspools, Subsurface Fluid Distribution Systems, and Drywells). The well must be closed in a manner that complies with ’331.5 of this title (relating to Prevention of Pollution) and 40 Code of Federal Regulations (CFR) ’144.12 (A prohibition of movement of fluid into underground sources of drinking water, effective June 2, 1987 at 48 FR 20676). Any contaminated soil, gravel, sludge, liquids, or other materials removed from or adjacent to the well must be managed in accordance with Chapter 350 of this title (relating to Texas Risk Reduction Program), and all other applicable federal, state, and local regulations and requirements.

(b) Closure shall be accomplished by removing all of the removable casing and the entire well shall be pressure filled via a tremie pipe with cement from bottom to the land surface.

(c) As an alternative to the procedure in subsection (b) of this section, if a Class V well is not completed through zones containing undesirable groundwater, water that is injurious to human health and the environment or water that can cause pollution to land or other waters, the well may be filled with fine sand, clay, or heavy mud followed by a cement plug extending from land surface to a depth of not less than ten feet below the land surface.

(d) As an alternative to the procedure in subsection (b) of this section, if a Class V well is completed through zones containing undesirable groundwater, water that is injurious to human health and the environment or water that can cause pollution to land or other waters, either the zone(s) containing undesirable groundwater or the fresh groundwater zone(s) shall be isolated with cement plugs and the remainder of the wellbore filled with bentonite grout (9.1 pounds per gallon mud or more) followed by a cement plug extending from land surface to a depth of not less than ten feet below the land surface.

(e) It is the responsibility of the owner or operator to ensure that temporary injection points are pressure grouted from the bottom of the well to the land surface, and the injection point is sealed to prevent the migration of fluids into underground sources of drinking water.

(f) It is the responsibility of the owner or operator to close improved sinkholes in a manner that prohibits the movement of contaminated fluids into underground sources of drinking water, in compliance with '331.5 of this title, and 40 CFR '144.12 (as amended through June 2, 1987 at 48 FR 20676); and to demonstrate that any fluids released through the closed well will meet the primary maximum contaminant levels (MCLs) for drinking water contained in 40 CFR Part 141, and other appropriate health-based standards at the point of injection.

'331.135. Construction Standards for Large Capacity Septic Systems

Not Applicable

'331.136. Closure Standards for Motor Vehicle Waste Disposal Wells, Large Capacity Septic Systems, Large Capacity Cesspools, Subsurface Fluid Distribution Systems, and Drywells

Not Applicable

'331.137. Permit for Motor Vehicle Waste Disposal Wells

Not Applicable

SUBCHAPTER I: FINANCIAL RESPONSIBILITY

'331.142. Financial Assurance

(a) The permittee shall secure and maintain financial assurance for plugging and abandonment in the amount of the plugging and abandonment cost estimate for Class I, Class I salt cavern disposal wells and associated salt caverns, and Class III wells in a manner that meets the requirements of Chapter 37, Subchapter Q of this title (relating to Financial Assurance for Underground Injection Control Wells). Financial assurance for plugging and abandonment shall be provided in the amount of the plugging and abandonment cost estimate as provided in '331.143 of this title (relating to Cost Estimate for Plugging and Abandonment). Financial assurance for post closure of Class I hazardous wells shall be provided in the amount of the post closure cost estimate.

(b) The permittee of a hazardous waste Class I waste injection well or Class I salt cavern disposal well and associated salt cavern shall establish and maintain sufficient liability coverage for bodily injury and property damage to third parties caused by sudden or nonsudden accidental occurrences arising from operations of the facility that meets the requirements of Chapter 37 of this title (relating to Financial Assurance) and '305.154(a)(11) of this title (relating to Standards).

(c) The requirement to maintain financial responsibility is enforceable regardless of whether the requirement is a condition of the permit.

’331.143. Cost Estimate for Plugging and Abandonment

(a) The owner or operator must prepare a written estimate, in current dollars, of the cost of plugging the well in accordance with the plugging and abandonment plan as specified in this chapter. The plugging and abandonment cost estimate must equal the cost of plugging and abandonment at the point in the facility’s operating life when the extent and manner of its operation would make plugging and abandonment the most expensive, as indicated by its plugging and abandonment plan.

(b) During the operating life of the facility, the owner or operator must keep at the facility the latest plugging and abandonment cost estimate prepared in accordance with subsection (a) of this section.

’331.144. Approval of Plugging and Abandonment

Within 60 days after receiving certifications from the owner or operator and an independent licensed professional engineer or licensed professional geoscientist that plugging and abandonment has been accomplished in accordance with the plugging and abandonment plan, the executive director will notify the owner or operator in writing that he is no longer required by this section to maintain financial assurance for plugging and abandonment of the well, unless the executive director has reason to believe that plugging and abandonment has not been in accordance with the plugging and abandonment plan. Financial assurance may not be released without the written approval of the executive director.

SUBCHAPTER J: STANDARDS FOR CLASS I SALT CAVERN SOLID WASTE DISPOSAL WELLS

Not Applicable

SUBCHAPTER K: ADDITIONAL REQUIREMENTS FOR CLASS V AQUIFER STORAGE WELLS

Not Applicable

Appendix D

Texas Natural Resource Conservation Commission Domestic Wastewater Effluent Limitation And Plant Siting

APPENDIX D TEXAS NATURAL RESOURCE CONSERVATION COMMISSION DOMESTIC WASTEWATER EFFLUENT LIMITATION AND PLANT SITING

CHAPTER 309

SUBCHAPTER A: DOMESTIC WASTEWATER EFFLUENT LIMITATIONS

SUBCHAPTER B: LOCATION STANDARDS

SUBCHAPTER C: LAND DISPOSAL OF SEWAGE EFFLUENT

SUBCHAPTER A: DOMESTIC WASTEWATER EFFLUENT LIMITATIONS

'309.1. Scope and Applicability

Figure D-1. 30 TAC '309.1 (b)

	Biochemical Oxygen Demand (BOD_5), 5-Day (mg/l)	Total Suspended Solids (TSS) (mg/l)	Dissolved Oxygen (DO) (mg/l)	pH (Standard Units)
30-Day Average	20	20		
7-Day Average	30	30		
Daily Maximum	45	45		
Single Grab	65	65	2.0 (minimum)	
				Within limits of 6.0-9.0

(a) The purpose of these sections is to promulgate a set of effluent quality limitations for treated domestic sewage which will be required of permittees as appropriate to maintain water quality in accordance with the commission's surface water quality standards. Any incorporation of federal regulations into this chapter shall apply only to disposal of domestic sewage.
(b) Secondary treatment, with exceptions applicable to certain stabilization pond systems and other natural systems, is defined as a minimum reduction of pollutants to meet the following quality:
(c) Effective April 1988, all permits containing an ammonia-nitrogen effluent limit are hereby modified to change BOD5 to carbonaceous biochemical oxygen demand (CBOD5).
(d) Effective January 1, 1988, any permit containing a BOD5 effluent limitation may be monitored and reported as CBOD5 as long as nitrogen is monitored and reported as ammonia-nitrogen at the same sampling frequency. If the permit authorizes a discharge to land or an evaporation pond only, ammonia-nitrogen monitoring and reporting are not required to change to CBOD5.
(e) The State of Texas has established a state water quality management program and a continuing planning process which sets forth the strategy and procedures for accomplishing the management program's objectives. Essential elements of the program include updates of basin plans, total maximum daily loads, and wasteload evaluations by basin segments. In order to achieve compliance with water quality standards within certain segments, more stringent effluent quality limitations other than basic secondary treatment may be required to protect water quality.

'309.2. Rationale for Effluent Sets.

(a) The effluent sets in '309.4 of this title (relating to **Table D-1**, Effluent Limitations for Domestic Wastewater Treatment Plants) are intended to represent standard levels of treatment normally required for domestic wastewater treatment plants.
(b) Modifications to the uniform sets of effluent criteria listed in '309.4 of this title may be considered by the commission when effluent limits more stringent than secondary treatment are required in order to maintain desired water quality levels.
(c) On a case-by-case basis, modifications to the uniform effluent criteria listed in '309.4 of this title may be considered by the commission for certain existing, natural systems which cannot

consistently meet pH or total suspended solids criteria due to the inherent variability of a particular system. Modifications to the criteria may be allowed for a natural system designed for treatment or polishing with a discharge directly into surface waters. Natural systems include, but are not necessarily limited to, aerated lagoons followed by stabilization ponds, facultative ponds, stabilization ponds, and constructed wetlands. For the purpose of this chapter, playa lakes are not considered natural systems. The commission will consider the following factors in approving a modification to the criteria:

(1) Any modification shall not allow a discharge which would cause a violation of the commission's surface water quality standards or any applicable total maximum daily loads (TMDLs) or wasteload evaluation.

(2) A proposal for a modification must be supported by an engineering report, prepared and sealed by a qualified professional engineer representing the permit applicant, which justifies the request for modification with specific information relating to the proposed design and that design's inherent limitations. For considering a request for modification of an existing system that cannot achieve permitted pH or TSS limitations, the engineering report must also document past efforts of design modification, operation, and maintenance, and include data showing for the past three years, influent and effluent hydraulic and organic loadings and the resultant effluent quality achieved.

(3) The commission may set narrative effluent limitations and effluent monitoring requirements as an alternative to a specific numerical effluent limitation when a specific numeric effluent limitation cannot be met because of, but not limited to, seasonal or operational factors. These narrative requirements shall ensure that necessary operational and maintenance actions are consistently carried out by the permittee to meet applicable water quality standards. The commission may request resumption of the original numerical limitations at the expiration of the permit based on a review of the discharge effluent data.

(4) The commission may suspend setting a specific numerical effluent limitation for a temporary period of time not to exceed the remainder of the permit term, pending a review of the actual performance of a natural system's design as long as the facility meets paragraph (1) of this subsection. During any temporary suspension, the permittee must document that the system is operated and maintained for optimal performance in accordance with an operation and maintenance manual prepared in accordance with Chapter 317 of this title (relating to Design Criteria for Sewerage Systems) and is meeting water quality standards. After review of performance data and related information submitted by the permittee in a permit application, at time of permit renewal or amendment, or when submitted at the request of the executive director, the commission may set specific numerical effluent limitations consistent with the criteria of this subchapter and the performance documented for the particular system.

’309.3. Application of Effluent Sets

(a) Discharges into effluent limited segments.

(1) All discharges into effluent limited segments shall, at a minimum, achieve secondary treatment. An effluent limited segment is any segment which is presently meeting or will meet applicable water quality criteria following incorporation of secondary treatment for domestic sewage treatment plants and/or best practicable treatment for industries.

(2) New or increased discharges into effluent limited segments shall achieve that level of treatment deemed necessary by the commission, based on the assimilative capacity and uses of the receiving stream.

(b) Discharges into water quality limited segments.

(1) All discharges into water quality limited segments for which evaluations have been developed shall, at a minimum, achieve the treatment level specified in the

recommendations of the evaluation for that discharge. A water quality limited segment is a surface water segment classified by the commission as water quality limited where conventional treatment of waste discharged to the segment is not stringent enough for the segment to meet applicable water quality standards; monitoring data have shown significant violations of water quality standards; advanced waste treatment for point sources is required to protect existing exceptional water quality; or the segment is a domestic water supply reservoir used to supply drinking water.

(2) Discharges into water quality limited segments for which wasteload evaluations or total maximum daily loads have not been developed shall, at a minimum, achieve secondary treatment as provided by '309.1 of this title (relating to Scope and Applicability).

(c) Discharges into certain reservoirs. Any discharge made within five miles upstream of a reservoir or lake which is subject to on-site/private sewage facility regulation adopted pursuant to Chapter 26 of the Texas Water Code or Article 4477-7e of the Texas Revised Civil Statutes, or which may be used as a source for public drinking water supply shall achieve, at a minimum, Effluent Set 2 in '309.4 of this title (relating to Table 1, Effluent Limitations for Domestic Wastewater Treatment Plants). Five miles shall be measured in stream miles from the normal conservation pool elevation. The commission may grant exceptions to this requirement where it can be demonstrated that the exception would not adversely impact water quality.

(d) Discharges from stabilization ponds. Effluent Set 3 shall apply to stabilization pond facilities in which stabilization ponds are the primary process used for secondary treatment and in which the ponds have been designed and constructed in accordance with applicable design criteria. Effluent Set 3 is considered equivalent to secondary treatment for stabilization pond systems.

(e) Discharge to an evaporation pond. Effluent discharged to evaporation ponds must receive, at a minimum, primary treatment, be within the pH limits of 6.0-9.0 standard units and have a quality of 100 mg/l BOD5 or less on a grab sample. For the purpose of this subsection, primary treatment means solids separation which is typically accomplished by primary clarifiers, Imhoff tanks, facultative lagoons, septic tanks, and other such units.

(f) Land disposal of treated effluent. The commission may authorize land disposal of treated effluent when the applicant demonstrates that the quality of ground or surface waters in the state will not be adversely affected. Each project must be consistent with laws relating to water rights. The primary purpose of such a project must be to dispose of treated effluent and/or to further enhance the quality of effluent prior to discharge.

(1) When irrigation systems ultimately dispose of effluent on land to which the public has access, Effluent Set 6, at a minimum, shall apply. The pH shall be within the limits of 6.0-9.0 standard units unless a specific variance is provided in the permit based upon site-specific conditions. When lands to which the public does not have access are to be used for ultimate disposal of effluent, the effluent must, at a minimum, receive primary treatment. Effluent Set 7 shall apply and the pH shall be within the limits of 6.0-9.0 standard units unless a specific variance is provided in the permit based upon site-specific conditions. For irrigation systems, primary treatment is the same as described in subsection (e) of this section. Effluent may be used for irrigation only when consistent with Subchapters B and C of this chapter (relating to Location Standards and Land Disposal of Sewage Effluent).

(2) When overland flow systems are utilized for effluent treatment, the public shall not have access to the treatment area. Primary treated effluent meeting Effluent Set 8, within the pH limits of 6.0-9.0 standard units may be used consistent with environmental safeguards and protection of ground and surface waters. For overland flow systems, primary treatment is the same as described in subsection (e) of this section. At a minimum, Effluent Set 1 shall apply to discharges from overland flow facilities except where more stringent treatment levels are required to meet water quality standards.

(3) When evapotranspiration beds, low pressure dosing, drip irrigation, or similar soil absorption systems are utilized for on-site land disposal, the effluent shall, at a minimum, receive primary treatment and meet Effluent Set 9. Use of these on-site systems shall be consistent with environmental safeguards and the protection of ground and surface waters. Primary treatment is the same as described in subsection (e) of this section.

(g) Disinfection

(1) Except as provided in this subsection, disinfection in a manner conducive to the protection of both public health and aquatic life shall be achieved on all domestic wastewater which discharges into waters in the state. Any appropriate process may be considered and approved on a case-by-case basis.

(2) Where chlorination is utilized, any combination of detention time and chlorine residual where the product of chlorine (Cl2 mg/l) X Time (T minutes) equals or exceeds 20 is satisfactory provided that the minimum detention time is at least 20 minutes and the minimum residual is at least 0.5 mg/l. The maximum chlorine residual in any discharge shall in no event be greater than four mg/l per grab sample, or that necessary to protect aquatic life. Where an existing system, constructed prior to October 8, 1990, has a detention time of less than 20 minutes at peak flow, the waste discharge permit will be amended at renewal by the commission to require limits for both chlorine residual and fecal coliform.

(3) On a case-by-case basis, the commission will allow chlorination or disinfection alternatives to the specific criteria of time and detention described in paragraph (2) of this subsection that achieve equivalent water quality protection. These alternatives will be considered and their performance standards determined based upon supporting data submitted in an engineering report, prepared and sealed by a registered, professional engineer. The report should include supporting data, performance data, or field tracer studies, as appropriate. The commission will establish effluent limitations as necessary to verify disinfection is adequate, including chlorine residual testing, other chemical testing, and/or fecal coliform testing.

(4) Except as provided herein, disinfection of domestic wastewater which is discharged by means of land disposal or evaporation pond shall be reviewed on a case-by-case basis to determine the need for disinfection. All effluent discharged to land to which the public has access must be disinfected and if the effluent is to be transferred to a holding pond or tank, the effluent shall be rechlorinated to a trace chlorine residual at the point of irrigation application.

(5) Unless otherwise specified in a permit, chemical disinfection is not required for stabilization ponds when the total retention time in the free-water-surface ponds (based on design flow) is at least 21 days.

(h) More stringent requirements. The commission may impose more stringent requirements in permits than those specified in subsections (a)-(g) of this section, on a case-by-case basis, where appropriate to maintain desired water quality levels.

’309.4. Table D-1. Effluent Limitations for Domestic Wastewater Treatment Plants

This table contains the sets of effluent criteria for waste discharge permits.

Table D-1. Effluent Limitations for Domestic Treatment Plants

		30-Day Average		7-Day Average		Daily Maximum		Single Grab		
Set	Direct Discharge	BOD_5	TSS	BOD_5	TSS	BOD_5	TSS	BOD_5	TSS	DO MIN
1	Secondary treatment	20	20	30	30	45	45	65	65	2.0
2	Enhanced secondary treatment	10	15	15	25	25	40	35	60	4.0
3	Stabilization ponds	30	90	45	--	70	--	100	--	4.0
	Land Treatment/Disposal									
6	Irrigation (public exposure)	20	20	30	30	45	45	65	65	--
	Using Stabilization ponds	30	90	45	--	70	--	100	--	--
7	Irrigation (no public exposure)	--	--	--	--	--	--	100	--	--
8	Overland flow (applied effluent)	--	--	--	--	--	--	100	--	--
9	Evapotranspiration beds, low pressure dosing, and drip irrigation	--	--	--	--	--	--	100	--	--

		30-Day Average			7-Day Average			Daily Maximum			Single Grab			
		$CBOD_5$	TSS	NH_3-N	$CBOD_5$	TSS	NH_3-N	$CBOD_5$	TSS	NH_3-N	$CBOD_5$	TSS	NH_3-N	DO DO MIN
	Enhanced													
2 N	Secondary with Nitrification	10	15	3	15	25	6	25	40	10	35	60	15	4.0
2 N 1	Secondary with Nitrification	10	15	2	15	25	5	25	40	10	35	60	15	4.0

SUBCHAPTER B: LOCATION STANDARDS

’309.10. Purpose, Scope and Applicability

(a) This chapter establishes minimum standards for the location of domestic wastewater treatment facilities. These standards are to be applied in the evaluation of an application for a permit to treat and dispose of domestic wastewater and for obtaining approval of construction plans and specifications. This chapter applies to domestic wastewater permit applications and construction plans and specifications filed on or after October 8, 1990, for new facilities and existing units which undergo substantial change for the continued purpose of domestic wastewater treatment.

(b) The purpose of this chapter is to condition issuance of a permit and/or approval of construction plans and specifications for new domestic wastewater treatment facilities or the substantial change of an existing unit on selection of a site that minimizes possible contamination of ground and surface waters; to define the characteristics that make an area unsuitable or inappropriate for a wastewater treatment facility; to minimize the possibility of exposing the public to nuisance conditions; and to prohibit issuance of a permit for a facility to be located in an area determined to be unsuitable or inappropriate, unless the design, construction, and operational features of the facility will mitigate the unsuitable site characteristics.

'309.11. Definitions

The following words and terms when used in this chapter, shall have the following meanings, unless the context clearly indicates otherwise:

(1) Active geologic processes - Any natural process which alters the surface and/or subsurface of the earth, including, but not limited to, erosion (including shoreline erosion along the coast), submergence, subsidence, faulting, karst formation, flooding in alluvial flood wash zones, meandering river bank cutting, and earthquakes.
(2) Aquifer - A geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs. Portions of formations, such as clay beds, which are not capable of yielding a significant amount of groundwater to wells or springs are not aquifers.
(3) Erosion - The group of natural processes, including weathering, deterioration, detachment, dissolution, abrasion, corrosion, wearing away, and transportation, by which earthen or rock material is removed from any part of the earth's surface.
(4) Existing facility - Any facility used for the storage, processing, or disposal of domestic wastewater and which has obtained approval of construction plans and specifications as of March 1, 1990.
(5) New facility - Any domestic wastewater treatment facility which is not an existing facility.
(6) Nuisance odor prevention - The reduction, treatment, and dispersal of potential odor conditions that interfere with another's use and enjoyment of property that are caused by or generated from a wastewater treatment plant unit, which conditions cannot be prevented by normal operation and maintenance procedures of the wastewater treatment unit.
(7) One hundred-year flood plain -- Any land area which is subject to a 1.0% or greater chance of flooding in any given year from any source.
(8) Substantial change in the function or use - an increase in the pollutant load or modification in the existing purpose of the unit.
(9) Wastewater treatment plant unit - Any apparatus necessary for the purpose of providing treatment of wastewater (i.e., aeration basins, splitter boxes, bar screens, sludge drying beds, clarifiers, overland flow sites, treatment ponds or basins that contain wastewater, etc.). For purposes of compliance with the requirements of '309.13(e) of this title (relating to Unsuitable Site Characteristics), this definition does not include off-site bar screens, off-site lift stations, flow metering equipment, or post-aeration structures needed to meet permitted effluent minimum dissolved oxygen limitations.
(10) Wetlands - Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, playa lakes, and similar areas.

'309.12. Site Selection to Protect Groundwater or Surface Water

The commission may not issue a permit for a new facility or for the substantial change of an existing facility unless it finds that the proposed site, when evaluated in light of the proposed design, construction or operational features, minimizes possible contamination of surface water and groundwater. In making this determination, the commission may consider the following factors:

(1) active geologic processes;

(2) groundwater conditions such as groundwater flow rate, groundwater quality, length of flow path to points of discharge and aquifer recharge or discharge conditions;
(3) soil conditions such as stratigraphic profile and complexity, hydraulic conductivity of strata, and separation distance from the facility to the aquifer and points of discharge to surface water; and
(4) climatological conditions.

’309.13. Unsuitable Site Characteristics.

(a) A wastewater treatment plant unit may not be located in the 100-year flood plain unless the plant unit is protected from inundation and damage that may occur during that flood event.
(b) A wastewater treatment plant unit may not be located in wetlands. (This prohibition is not applicable to constructed wetlands.)
(c) A wastewater treatment plant unit may not be located closer than 500 feet from a public water well as provided by ’290.41(c)(1)(B) of this title (relating to Ground Water Sources and Development) nor 250 feet from a private water well. The following separation distances apply to any facility used for the storage, processing, or disposal of domestic wastewater. Exceptions to these requirements will be considered at the request of a permit applicant on a case-by-case basis, and alternative provisions will be established in a permit if the alternative condition provides adequate protection to potable water sources and supplies:
(1) A wastewater treatment plant unit, land where surface irrigation using wastewater effluent occurs, or soil absorption systems (including low pressure dosing systems, drip irrigation systems, and evapotranspiration beds) must be located a minimum horizontal distance of 150 feet from a private water well;
(2) A wastewater treatment plant unit, or land where surface irrigation using wastewater effluent occurs, must be located a minimum horizontal distance of 500 feet from an elevated or ground potable-water storage tank as provided by ’290.43 (b)(1) of this title (relating to Location of Clear Wells, Standpipes, and Ground Storage and Elevated Tanks.);
(3) A wastewater treatment plant unit, or land where surface irrigation using wastewater effluent occurs, must be located a minimum horizontal distance of 500 feet from a public water well site as provided by ’290.41(c)(1)(C) of this title, spring, or other similar sources of public drinking water;
(4) A wet well or pump station at a wastewater treatment facility must be located a minimum horizontal distance of 300 feet from a public water well site, spring, or other similar sources of public drinking water as provided by ’290.41(c)(1)(B) of this title; and
(5) A wastewater treatment plant unit, or land where surface irrigation using wastewater effluent occurs must be located a minimum horizontal distance of 500 feet from a surface water treatment plant as provided by ’290.41(e)(3)(A) of this title.
(d) A wastewater treatment facility surface impoundment may not be located in areas overlying the recharge zones of major or minor aquifers, as defined by the Texas Water Development Board, unless the aquifer is separated from the base of the containment structure by a minimum of three feet of material with a hydraulic conductivity toward the aquifer not greater than 10-7 cm/sec or a thicker interval of more permeable material which provides equivalent or greater retardation of pollutant migration. A synthetic membrane liner may be substituted with a minimum of 30 mils thickness and an underground leak detection system with appropriate sampling points.
(e) One of the following alternatives must be met as a compliance requirement to abate and control a nuisance of odor prior to construction of a new wastewater treatment plant unit, or substantial change in the function or use of an existing wastewater treatment unit:
(1) Lagoons with zones of anaerobic activity (e.g., facultative lagoons, un-aerated equalization basins, etc.) may not be located closer than 500 feet to the nearest property line. All other wastewater treatment plant units may not be located closer than 150 feet to the nearest

property line. Land used to treat primary effluent is considered a plant unit. Buffer zones for land used to dispose of treated effluent by irrigation shall be evaluated on a case-by-case basis. The permittee must hold legal title or have other sufficient property interest to a contiguous tract of land necessary to meet the distance requirements specified in this paragraph during the time effluent is disposed by irrigation;

(2) The applicant must submit a nuisance odor prevention request for approval by the executive director. A request for nuisance odor prevention must be in the form of an engineering report, prepared and sealed by a licensed professional engineer in support of the request. At a minimum, the engineering report shall address existing climatological conditions such as wind velocity and atmospheric stability, surrounding land use which exists or which is anticipated in the future, wastewater characteristics in affected units pertaining to the area of the buffer zone, potential odor generating units, and proposed solutions to prevent nuisance conditions at the edge of the buffer zone and beyond. Proposed solutions shall be supported by actual test data or appropriate calculations. The request shall be submitted, prior to construction, either with a permit application and subject to review during the permitting process or submitted for executive director approval after the permitting process is completed; or,

(3) The permittee must submit sufficient evidence of legal restrictions prohibiting residential structures within the part of the buffer zone not owned by the applicant. Sufficient evidence of legal restriction may, among others, take the form of a suitable restrictive easement, right-of-way, covenant, deed restriction, deed recorded, or a private agreement provided as a certified copy of the original document. The request shall be submitted, prior to construction, either with a permit application and subject to review during the permitting process or submitted for executive director approval after the permitting process is completed.

(f) For a facility for which a permit application, other than a renewal application, is made after October 8, 1990, if the facility will not meet the buffer zone requirement by one of the alternatives described in subsection (e) of this section, the applicant shall include in the application for the discharge permit a request for a variance. A variance will be considered on a case-by-case basis and, if granted by the commission, shall be included as a condition in the permit. This variance may be granted by the commission, consistent with the policies set out in Texas Water Code, '26.003.

(g) Any approved alternative for achieving the requirements of this subsection must remain in effect as long as the commission permits the wastewater treatment plant. To comply with this requirement, the permittee must carry out the nuisance odor prevention plan at all times, shall ensure sufficient property ownership or interest and shall maintain easements prohibiting residential structures, as appropriate.

(h) For a permitted facility undergoing renewal of an existing permit with plans and specifications approved prior to March 1, 1990, for which no design change is requested, the facility will not be required to comply with the requirements of this subsection.

(i) Facilities for which plans and specifications have been approved prior to March 1, 1990, are not required to resubmit revised plans and specifications to meet changed requirements in this section in obtaining renewal of an existing permit.

'309.14. Prohibition of Permit Issuance

(a) The commission may not issue, amend, or renew a permit for a wastewater treatment plant if the facility does not meet the requirements of '309.13 of this title (relating to Unsuitable Site Characteristics).

(b) Nothing in this chapter shall be construed to require the commission to issue a permit, notwithstanding a finding that the proposed facility would satisfy the requirements of '309.12 of this title (relating to Site Selection to Protect Groundwater or Surface Water) and notwithstanding the absence of site characteristics which would disqualify the site from permitting pursuant to '309.13 of this title (relating to Unsuitable Site Characteristics).

SUBCHAPTER C: LAND DISPOSAL OF SEWAGE EFFLUENT

'309.20. Land Disposal of Sewage Effluent

(a) Technical report. Each project shall be accompanied by a preliminary engineering report outlining the design of the wastewater disposal system. The report shall include maps, diagrams, basis of design, calculations, and other pertinent data as described in this section.

(1) Location

(A) Site map. A copy of the United States Geological Survey topographic map of the area which indicates the exact boundaries of the disposal operation will be included in the technical report. A map from the 7 1/2 minute series is required if it is published for the site area.

(B) Site drawing. A scale drawing and legal description of all land which is to be a part of the disposal operation will be included in the technical report. The drawing will show the location of all existing and proposed facilities to include: buildings, waste disposal or treatment facilities, effluent storage and tail water control facilities, buffer zones, and water wells. This drawing should have an index of wells, adjacent property, and other prominent features. Ownership of land tracts adjacent to the irrigated land shall be shown on the site drawing and identified by listing legal ownership.

(2) Geology. The existence of any unusual geological formations such as faults or sinkholes on the waste disposal site shall be noted in the technical report and identified on the site map. The conceptual design of the waste disposal system shall include appropriate engineering considerations with respect to limitations presented by these features.

(3) Soils. A general survey of soils with regard to standard classifications shall be compiled for all areas of waste application to the soil. Soil surveys compiled by the United States Department of Agriculture Soil Conservation Service shall be utilized where available. Conceptual design aspects related to waste application rates, crop systems, seepage and runoff controls shall be based upon the soil physical and chemical properties, hydraulic characteristics, and crop use suitabilities for the waste application site.

(4) Groundwater quality. The technical report shall fully assess the impact of the waste disposal operation on the uses of local groundwater resources. In regard to performing this assessment, the report shall systematically address subparagraphs (A) and (B) of this paragraph.

(A) All water wells within a half mile radius of the disposal site boundaries shall be located. If available, the water uses from each well shall be identified. In addition, aspects of construction such as well logs, casing, yield, static elevation, water quality, and age shall be furnished and evaluated in the technical report. Local groundwater resources below the wastewater disposal site shall be monitored to establish preoperational baseline groundwater quality when monitoring wells are available. Monitoring shall provide the following analytical determination: total dissolved solids, nitrate nitrogen, chlorides, sulfates, pH, and coliform bacteria.

(B) Groundwater resources serving as sources or potential sources of domestic raw water supply will be protected by limiting wastewater application rates. Effluent storage and/or treatment ponds presenting seepage hazards to these groundwater resources shall be constructed with adequate liners.

(5) Agricultural practice. The technical report shall describe the crop system proposed for the waste disposal operation. This description shall include a discussion of the adaptability of

the crop to the particular soil, climatological, and wastewater sensitivity conditions that will exist at the waste disposal site. Annual nutrient uptake of the crop system shall be specified, and crop harvesting frequencies shall be described within the report.

(b) Irrigation. Irrigation disposal systems utilize effluent to supply the growth needs of the cover crop.

(1) Secondary effluent. Land disposal system operators who use land accessible to the general public shall provide a degree of treatment equivalent to secondary treatment standards, as defined by the commission, prior to application of waste to land areas.

(2) Primary effluent. Land disposal systems may provide for the disposal of effluent from primary treatment units provided that the wastewater disposal system conforms with the requirements contained in subparagraphs (A)-(E) of this paragraph.

(A) The wastewater disposal system shall be designed and operated to prevent a discharge from entering surface waters, and to prevent recharge of groundwater resources which supply or offer the potential of supplying domestic raw water.

(B) The land disposal system shall be designed and operated to achieve disposal of effluent without adversely affecting the agricultural productivity of the land disposal site.

(C) The economic benefits derived from agricultural operations carried out at the land disposal site are secondary to the proper disposal of wastewater.

(D) The sewerage system owner shall maintain direct responsibility and control over all aspects of the sewage pretreatment and application operations, as well as all aspects of any agricultural activities carried out on the disposal site.

(E) The land disposal system shall contain sufficient area to provide for normal expansion of the facility service area. In most cases, the disposal system shall have a design life of at least 20 years.

(3) Design analysis. The designing engineers shall utilize a detailed design analysis of limiting hydraulic and nutrient application rates, and effluent storage needs, as the basis of the disposal system design. All projects shall include the detailed design analysis described in subparagraphs (A)-(C) of this paragraph.

(A) Hydraulic application rate. A water balance study shall be provided as a part of a detailed application rate analysis in order to determine the irrigation water requirement, including a leaching requirement if needed, for the crop system on the wastewater application areas. The water balance study should generally follow the example development shown in **Table D-2** of this subparagraph. Precipitation inputs to the water balance shall utilize the average yearly rainfall and the monthly precipitation distribution based on past rainfall records. The consumptive use requirements (evapotranspiration losses) of the crop system shall be developed on a monthly basis. The method of determining the consumptive use requirement shall be documented as a part of the water balance study. A leaching requirement, calculated as shown in Table D-2 of this subparagraph, shall be included in the water balance study when the total dissolved solids concentration of the effluent presents the potential for developing excessive soil salinity buildup due to the long term operation of the irrigation system.

(B) Effluent storage. An effluent storage study shall be performed to determine the necessary storage requirements. The storage requirements shall be based on a design rainfall year with a return frequency of at least 25 years (the expected 25 year - one year rainfall, alternately the highest annual rainfall during the last 25 years of record may be used) and a normal monthly distribution, the application rate and cycle, the effluent available on a monthly basis, and evaporation losses. An example of an effluent storage study is shown in **Table D-3** of this subparagraph.

(C) Nitrogen application rate. Irrigation shall be limited to prevent excessive nitrogen application. The annual liquid loading shall not exceed that which would introduce more nitrogen than is annually required by the crop plus 20% volatilization. Values of crop nitrogen requirements shall be justified in the design report. The application rate shall be calculated by the formula:

$$L = \frac{N}{2.7C} \text{ where,}$$

L = annual liquid loading - feet/year

C = effluent nitrogen concentration - mg/l

N = annual crop requirement of nitrogen plus 20% volatilization pound/acre/yr.

TABLE D-3. Example Calculation of Storage Volume Requirements

(All Units are Inches of Water per Acre of Irrigated Area)

Month	Effluents received for Application or Storage	Rainfall Worst Year in Past 25 Year	Runoff Wortst Year in Past 25 Year	Infiltrated Rainfall (14)-(15)	Available Water (13)+(16)	Net 25 Year Low Evaporation from Regur.Surf.	Storage	Accumulated Storage
(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Jan.	2.70	3.28	1.09	2.19	4.89	0.00	2.69	8.49
Feb.	2.70	3.80	1.45	2.35	5.05	0.01	2.69	11.18
Mar.	2.70	3.18	1.02	2.16	4.86	0.04	1.67	12.85
April	2.70	4.98	2.35	2.63	5.33	0.02	1.51	14.36
May	2.70	6.57	3.67	2.90	5.60	0.04	-1.86	12.50
June	2.70	5.13	2.47	2.66	5.36	0.09	-2.80	9.70
July	2.70	3.44	1.20	2.24	4.94	0.16	-3.73	5.97
Aug.	2.70	3.33	1.12	2.21	4.91	0.16	-0.87	5.10
Sept.	2.70	5.59	2.84	2.75	5.45	0.08	-0.74	4.36
Oct.	2.70	4.82	2.22	2.60	5.30	0.07	0.45	0.45
Nov.	2.70	3.49	1.23	2.26	4.96	0.03	2.67	3.12
Dec.	2.70	3.64	1.34	2.30	5.00	0.02	2.68	5.80
	32.40	51.25	22.00	29.25	61.65	0.73		

a. For calculation purposes only, disposal rate is for a 240,000 gpd facility (2.7 Ac.-ft/AC./yr.) irrigating 100 Acres. Maximum values for Column 13 are the value (total) of Column 11 divided by 12. Note that the values in Column 13 could be adjusted to allow for seasonal variation in effluent output.

b. Annual rainfall amount from the worst year in past 25 years of data. Total rainfall is then distributed proportional to monthly averages.

c. Using rainfall figures in Column 14, calculate runoff with the same method used in Column 3.

d. Lowest annual evaporation in past 25 years from reservoir surface. Distribute annual value proportionally to monthly average evaporation expressed in inches per irrigated acre. For purpose of this calculation, irrigation area = 100 acres and reservoir surface area = 5 acres. Therefore, values in Column 18 are 5% of Evaporation figures for Austin, Texas.

e. Storage = [(13)-(18)]-{[(7)-(16)]/k}. If the term {[(7)-(16)]/k} is negative, then the value for storage = [(13)-(18)]. Irrigation efficiency is 0.85 unless specific information is provided to support a different value.

f. To allow for the worst condition, the summation was started in Oct., which gives a maximum storage requirement of 14.36 in./irrigated acre or 120 Acre-feet.

(4) Soil testing. Representative soil samples shall be taken from the root zones of wastewater application sites to establish pre-operational soil concentrations of pH, total nitrogen, potassium, phosphorus, and conductivity. Sampling procedures shall employ accepted techniques of soil science for obtaining representative analytical results. Base-line values of the parameters specified in paragraph 3(C) of this subsection shall be furnished in the technical report. The project development shall provide for a minimum of one soil test annually from each wastewater application site for the duration of the disposal system design life.

(5) Standard irrigation best management practices

(A) Screening devices should be installed on all lift pump suction intakes.

(B) The design of sprinkler irrigation systems should allow operational flexibility and efficiency and ease of maintenance.

(i) The system should be designed to provide a uniform water distribution.

(ii) The designing engineer should consider such items as permanently buried mains with readily accessible valve boxes, two or more lateral lines, and quick coupling valves at the main/lateral connections.

(iii) Cross connection with a potable water supply system is prohibited. Cross connection with a well water system will be reviewed on a case-by-case basis.

(C) Vehicular access to conveyance system locations and equipment should be provided at intervals of 1,000 feet to 1,300 feet.

(D) The cover crop of each wastewater application area shall be harvested a minimum of once per year. Consideration should be given to the selection of crops which will allow two or more harvests per year to be made.

(E) All effluent applied as irrigation water should have a pH within the range of 6.0 to 9.0.

(c) Percolation. Percolation disposal systems provide for ultimate disposal of the wastewater by evaporation and percolation with no resulting discharge to surface waters.

(1) Percolation systems will not be permitted in those locations where seepage would adversely affect the uses of groundwater resources.

(2) Primary treatment of the raw sewage shall be provided prior to land disposal.

(3) Percolation systems shall be limited to sites having soil textures suitable for sustaining a rapid intake rate. Percolation dosing sites shall be limited to soils classified as sands, loamy sands, or sandy loams having a minimum infiltration rate of six inches per hour.

(4) Multiple dosing basins shall be provided for the application of wastewater. The wastewater distribution system shall be designed to provide a maximum dosing period of 24 hours upon any individual dosing basin and a minimum resting period for any individual dosing basin of five days following a period of dosing.

(5) The hydraulic loading rate will be considered on a case-by-case basis. The designing engineer shall identify the permeability of the limiting soil layer.

(6) The design shall provide an area equal to a minimum of 20% of the total disposal site area for the construction of wastewater storage for utilization during periods of wet or freezing weather and to provide flexibility of dosing site utilization.

Appendix E

Soil Unit Characteristics

Map Unit	Component	Slope (percent)	Elevation (m)	Runoff	Drainage	Geomorphology	Taxonomic Classification	Taxonomic Order	Taxpartsize	Taxtempcl	Taxmoistscl	Water Erodibility	Wind Erodibility	Infiltration Rate
Altuda-Rock outcrop complex	Altuda	5-15	1494-1829	Very high	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls	Mollisols	loamy-skeletal	thermic	Ustic	Potentially high	High	Very slow
Altuda-Rock outcrop complex	Altuda	35-65	1494-1829	Very high	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls	Mollisols	loamy-skeletal	thermic	Ustic	High	High	Very slow
Altuda-Rock outcrop complex	Altuda	15-35	1494-1829	Very high	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls	Mollisols	loamy-skeletal	thermic	Ustic	Potentially high	High	Very slow
Bankston extremely channery loam	Bankston	8-15	1281-1616	High	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Ustic Haplocalcids	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Not high	Not high	Slow
Bankston extremely channery loam	Bankston	15-35	1281-1616	High	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Ustic Haplocalcids	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Potentially high	Not high	Slow
Bissett-Rock outcrop complex	Bissett	35-65	1281-1616	Very high	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Lithic Ustic Haplocalcids	Aridisols	loamy-skeletal	thermic	Aridic (torric)	High	High	Very slow
Bissett-Rock outcrop complex	Bissett	15-35	1281-1616	Very high	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Lithic Ustic Haplocalcids	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Potentially high	High	Very slow
Bissett-Rock outcrop complex	Bissett	5-15	1281-1616	Very high	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Lithic Ustic Haplocalcids	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Potentially high	High	Very slow
Cavalry loamy fine sand	Cavalry	1-3	1189-1281	Very low	Well drained	alluvial flat on basin floor	Coarse-loamy, mixed, superactive, thermic Typic Calciargids	Aridisols	coarse-loamy	thermic	Aridic (torric)	Not high	High	High
Copia loamy fine sand	Copia	5-15	1189-1281	Low	Excessively drained	Dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	High
Copia-Mcnew-Pendero complex	Copia	1-3	1189-1281	Very low	Excessively drained	shrub-coppice dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	Moderate
Copia-Mcnew-Pendero complex	McNew	1-3	1189-1281	Low	Well drained	alluvial flat on basin floor	Fine-loamy, mixed, superactive, thermic Typic Calciargids	Aridisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Moderate
Copia-Mcnew-Pendero complex	Pendero	2-5	1189-1281	Very low	Excessively drained	sand sheet on basin floor	Sandy, mixed, thermic Typic Haplargids	Aridisols	Sandy	thermic	Aridic (torric)	Not high	High	Moderate
Copia-Nations complex	Copia	1-3	1189-1281	Very low	Excessively drained	shrub-coppice dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	High
Copia-Patriot complex	Copia	2-5	1189-1281	Very low	Excessively drained	shrub-coppice dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	High
Crossen gravelly fine sandy loam	Crossen	2-5	1281-1616	Very high	Well drained	fan remnant	Loamy, carbonatic, thermic, shallow Calcic Petrocalcids	Aridisols	Loamy	thermic	Aridic (torric)	Not high	High	Very slow
Crossen-Tinney complex	Crossen	1-3	1281-1616	Very high	Well drained	fan remnant	Loamy, carbonatic, thermic, shallow Calcic Petrocalcids	Aridisols	Loamy	thermic	Aridic (torric)	Not high	High	Very slow
Dozer-Rock outcrop complex	Dozer	5-15	1189-1281	Very high	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Lithic Torriorthents	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Potentially high	High	Very slow
Dozer-Rock outcrop complex	Dozer	15-35	1189-1281	Very high	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Lithic Torriorthents	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Potentially high	High	Very slow

Map Unit	Component	Slope (percent)	Elevation (m)	Runoff	Drainage	Geomorphology	Taxonomic Classification	Taxonomic Order	Taxpartsize	Taxtempcl	Taxmoistscl	Water Erodibility	Wind Erodibility	Infiltration Rate
Dozer-Rock outcrop complex	Dozer	35-65	1189-1281	Very high	Well drained	Hill	Loamy-skeletal, carbonatic, thermic Lithic Torriorthents	Aridisols	loamy-skeletal	thermic	Aridic (torric)	High	High	Very slow
Dumps	Dumps		-									Not high	High	
Elizario-Copia complex	Copia	2-5	1189-1281	Very low	Excessively drained	shrub-coppice dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	Moderate
Elizario-Copia complex	Elizario	2-5	1189-1281	Medium	Well drained	alluvial flat on basin floor	Fine-loamy, mixed, superactive, thermic Typic Calciargids	Aridisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Moderate
Foxtrot-Copia complex	Copia	1-5	1189-1281	Very low	Excessively drained	shrub-coppice dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	Slow
Foxtrot-Copia complex	Foxtrot	0-5	1189-1281	High	Well drained	alluvial flat on basin floor	Fine-loamy, mixed, superactive, thermic Argic Petrocalcids	Aridisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Slow
Hueco loamy fine sand	Hueco	1-3	1189-1281	High	Well drained	Basin floor	Coarse-loamy, mixed, superactive, thermic Argic Petrocalcids	Aridisols	coarse-loamy	thermic	Aridic (torric)	Not high	High	Slow
Infantry-Sonic complex	Infantry	3-10	1281-1616	Very high	Well drained	erosion remnant on fan piedmont	Loamy-skeletal, carbonatic, thermic, shallow Calcic Petrocalcids	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Not high	High	Very slow
Infantry-Sonic complex	Sonic	3-10	1281-1616	High	Well drained	inset fan on fan piedmont	Loamy-skeletal, carbonatic, thermic Ustifluventic Haplocambids	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Not high	High	Very slow
Malargo silt loam	Malargo	1-3	1281-1616	Medium	Well drained	fan piedmont	Fine-loamy, gypsic, thermic Ustic Haplogypsids	Aridisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Moderate
Mariola fine sandy loam	Mariola	1-3	1281-1616	High	Well drained	erosion remnant on fan piedmont	Fine-loamy, mixed, superactive, thermic Ustalfic Petrocalcids	Aridisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Slow
Mcnew sandy loam	McNew	1-3	1189-1281	Low	Well drained	alluvial flat on basin floor	Fine-loamy, mixed, superactive, thermic Typic Calciargids	Aridisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Moderate
Mcnew-Copia complex	Copia	2-5	1189-1281	Very low	Somewhat excessively drained	shrub-coppice dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	Moderate
Mcnew-Copia complex	McNew	2-5	1189-1281	Low	Well drained	alluvial flat on basin floor	Fine-loamy, mixed, superactive, thermic Typic Calciargids	Aridisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Moderate
Mcnew-Copia-Foxtrot complex	Copia	1-3	1189-1281	Very low	Excessively drained	shrub-coppice dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	Moderate
Mcnew-Copia-Foxtrot complex	Foxtrot	2-5	1189-1281	High	Well drained	alluvial flat on basin floor	Fine-loamy, mixed, superactive, thermic Argic Petrocalcids	Aridisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Moderate
Mcnew-Copia-Foxtrot complex	McNew	1-3	1189-1281	Low	Well drained	alluvial flat on basin floor	Fine-loamy, mixed, superactive, thermic Typic Calciargids	Aridisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Moderate
Miscellaneous water	miscellaneous water		-									Not high	High	
Oryx-Reyab complex	Reyab	1-3	1433-1829	Medium	Well drained	inset fan on fan piedmont	Fine-silty, mixed, superactive, thermic Ustic Haplocambids	Aridisols	fine-silty	thermic	Aridic (torric)	Not high	High	Moderate

Map Unit	Component	Slope (percent)	Elevation (m)	Runoff	Drainage	Geomorphology	Taxonomic Classification	Taxonomic Order	Taxpartsize	Taxtempcl	Taxmoistscl	Water Erodibility	Wind Erodibility	Infiltration Rate
Pendero fine sand	Pendero	2-5	1189-1281	Very low	Excessively drained	sand sheet on basin floor	Sandy, mixed, thermic Typic Haplargids	Aridisols	Sandy	thermic	Aridic (torric)	Not high	High	Moderate
Pendero-Copia-Nations complex	Copia	2-5	1189-1281	Very low	Excessively drained	shrub-coppice dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	Moderate
Pendero-Copia-Nations complex	Pendero	2-5	1189-1281	Very low	Excessively drained	sand sheet on basin floor	Sandy, mixed, thermic Typic Haplargids	Aridisols	Sandy	thermic	Aridic (torric)	Not high	High	Moderate
Pits	Pits		-									Not high	High	
Reyab loam	Reyab	1-5	1433-1829	Medium	Well drained	inset fan on fan piedmont	Fine-silty, mixed, superactive, thermic Ustic Haplocambids	Aridisols	fine-silty	thermic	Aridic (torric)	Not high	High	Moderate
Reyab loam	Reyab	0-1	1433-1829	Low	Well drained	inset fan on fan piedmont	Fine-silty, mixed, superactive, thermic Ustic Haplocambids	Aridisols	fine-silty	thermic	Aridic (torric)	Not high	High	Moderate
Reyab loam, ponded	Reyab	0-1	1433-1829	Low	Well drained	inset fan on fan piedmont	Fine-silty, mixed, superactive, thermic Ustic Haplocambids	Aridisols	fine-silty	thermic	Aridic (torric)	Not high	High	Moderate
Reyab silt loam	Reyab	0-1	1281-1616	Low	Well drained	fan apron on fan piedmont, inset fan on fan piedmont	Fine-silty, mixed, superactive, thermic Ustic Haplocambids	Aridisols	fine-silty	thermic	Aridic (torric)	Not high	High	Moderate
Reyab silt loam	Reyab	1-3	1281-1616	Medium	Well drained	inset fan on fan piedmont	Fine-silty, mixed, superactive, thermic Ustic Haplocambids	Aridisols	fine-silty	thermic	Aridic (torric)	Not high	High	Moderate
Sonic very gravelly fine sandy loam	Sonic	1-8	1281-1616	Medium	Well drained	inset fan on fan piedmont	Loamy-skeletal, carbonatic, thermic Ustifluventic Haplocambids	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Not high	High	Moderate
Sonic very gravelly fine sandy loam	Sonic	8-15	1281-1616	High	Well drained	inset fan on fan piedmont	Loamy-skeletal, carbonatic, thermic Ustifluventic Haplocambids	Aridisols	loamy-skeletal	thermic	Aridic (torric)	Not high	High	Moderate
Wessly-Copia complex	Copia	1-3	1189-1281	Very low	Excessively drained	shrub-coppice dune	Mixed, thermic Typic Torripsamments	Entisols	-	thermic	Aridic (torric)	Not high	High	Moderate
Wessly-Copia complex	Wessly	1-3	1189-1281	Negligible	Well drained	depression on alluvial flat on basin floor	Fine-loamy, mixed, superactive, calcareous, thermic Typic Torriorthents	Entisols	fine-loamy	thermic	Aridic (torric)	Not high	High	Moderate

Based on NRCS 2002.

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Appendix F

Groundwater Resources in the Hueco Bolson

APPENDIX F GROUNDWATER RESOURCES IN THE HUECO BOLSON

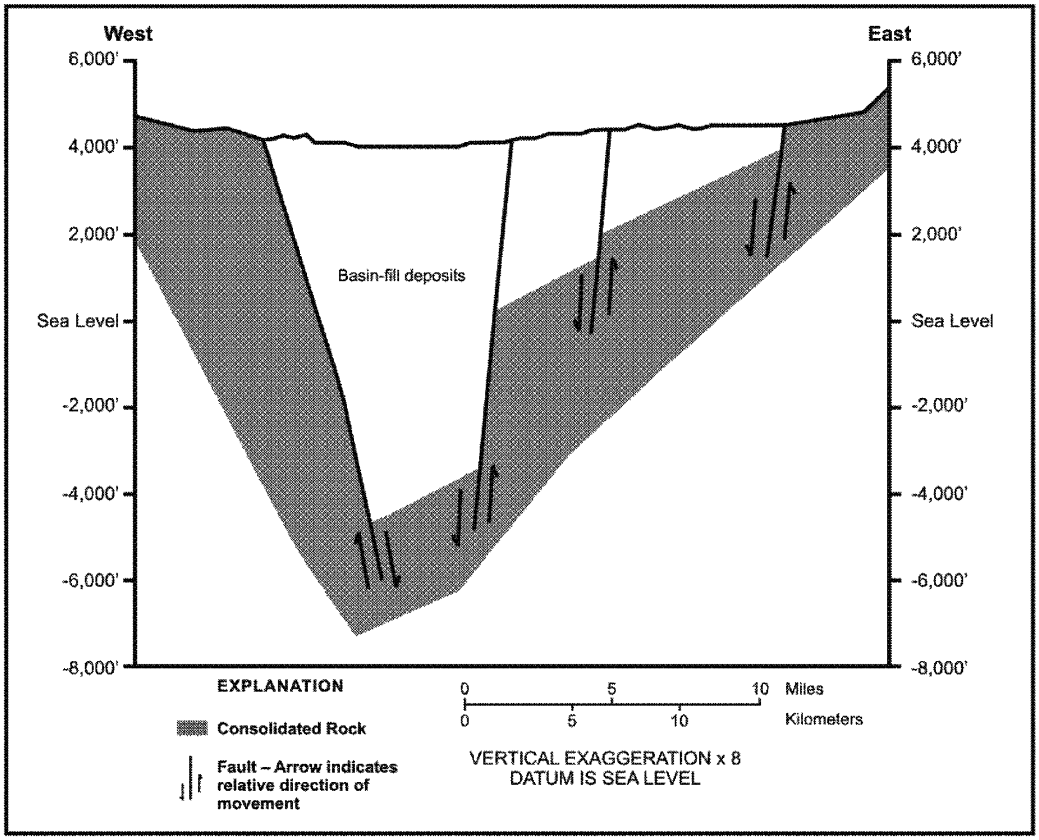
F.1 GROUNDWATER RESOURCE

The Hueco Bolson is an intermontane basin. It is incised by the Rio Grande Valley which extends north from El Paso County, Texas, to parts of Doña Ana and Otero counties in south-central New Mexico. The bolson is bounded on the east by the Hueco Mountains and Otero Mesa and on the west by the Franklin and Organ mountains. A gentle topographic rise, 5 to 10 miles north of the New Mexico-Texas state line, separates the Hueco Basin from the geologically similar Tularosa Basin to the north (Orr and White 1985). However, the topographic divide is not a groundwater divide (Knowles and Kennedy 1958), and the Hueco Bolson and Tularosa Basin are hydraulically connected (Wilkins 1986).

The Hueco Bolson contains basin-fill sedimentary deposits that extend northward into the Tularosa Basin and southward into the lower Hueco Bolson. The deposits are bounded by less permeable carbonate rocks of the Hueco Mountains and the Otero Mesa escarpment to the east; by less permeable rocks of the Organ and Franklin mountains to the west; and are underlain by less permeable consolidated rocks. Data from geophysical surveys and deep test wells indicate that basin-fill deposits in the trough are as much as 9,000 feet thick (Orr and Risser 1992). The thickness of the basin-fill deposits taper to near zero eastward from the trough and near the base of the Hueco Mountains and the Otero Mesa escarpment (**Figure F-1**). Sediments filling the basins have been designated the Hueco-Tularosa Aquifer (Hibbs et al. 1998) because of the geologic similarities and hydrogeologic interconnection. Within the influence of the Rio Grande, the bolson sediment is overlain by 200 to 250 feet of Rio Grande alluvium consisting of coarse sand and gravel.

Drilling records; geophysical well logs; and seismic refraction, gravity, and resistivity surveys in the northern portion of the Hueco Bolson indicate that the thickest basin-fill deposits occurs as a trough-shaped body near and parallel with the Franklin Mountains (Gates et al. 1980). The extensive sand, gravel, and clay deposits extend south from the Tularosa Basin into the Hueco Bolson (Rapp 1958). A deep boring drilled 12 miles north of El Paso encountered 4,363 feet of basin-fill sediment consisting of sand and gravel in the upper 600 feet, interlayered sand and clay between 600 and 2,300 feet, and lacustrine clay to a depth of 4,363 feet (Davis and Leggat 1967). Extensive surveys over the southern Hueco Bolson indicated basin-fill between 1,000 to 5,000 feet thick between El Paso and Espeanza (Gates and Stanley 1976). The drilled thickness of the basin sediment in the southern Hueco-Bolson has ranged from 970 feet to 2,040 feet. (Gates and Stanley 1976). Bolson deposits underlying the remainder of the El Paso Valley are predominantly clay with lesser interlayered sand.

Groundwater generally occurs under water table (unconfined) conditions in the Rio Grande alluvium overlying the bolson sediment and partially under artesian conditions where sand layers are sufficiently confined by clay in the bolson deposits (Gates et al. 1980). Along the Rio Grande floodplain between El Paso and Ysleta and at Fabens in the southern portion of the bolson, water in the bolson deposits is under slight artesian pressure (Davis and Leggat 1965; Gates et al. 1980). Water in the City Artesian Zone and the Fabens Artesian Zone is fresh because of its proximity to recharge and the coarseness of the aquifer in this area. Under favorable conditions of sand and clay interlayering, localized artesian conditions are also likely in other areas of the bolson.



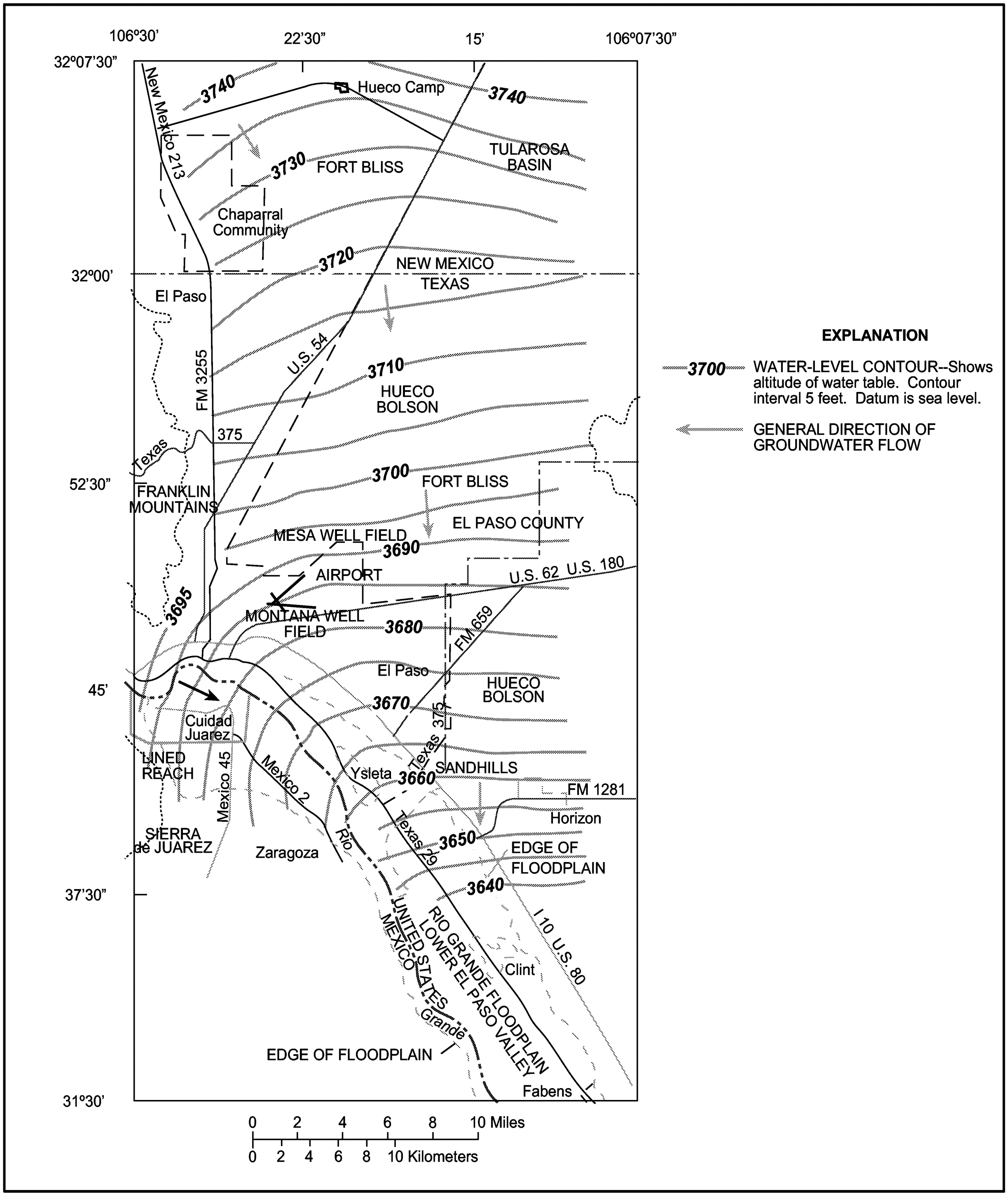
Source: Orr and Risser 1992

Figure F-1. Generalized West-to-East Geologic Section of the Hueco Bolson

The depth to groundwater in the Hueco-Tularosa aquifer varies from 20 to 151 feet below land surface (BLS) at Tularosa and Alamogordo, New Mexico; 298 to 351 feet BLS at White Sands Missile Range, New Mexico; 249 to 400 feet BLS at El Paso, Texas; and 98 to 249 feet BLS at Ciudad Juárez (Hibbs et al. 1998).

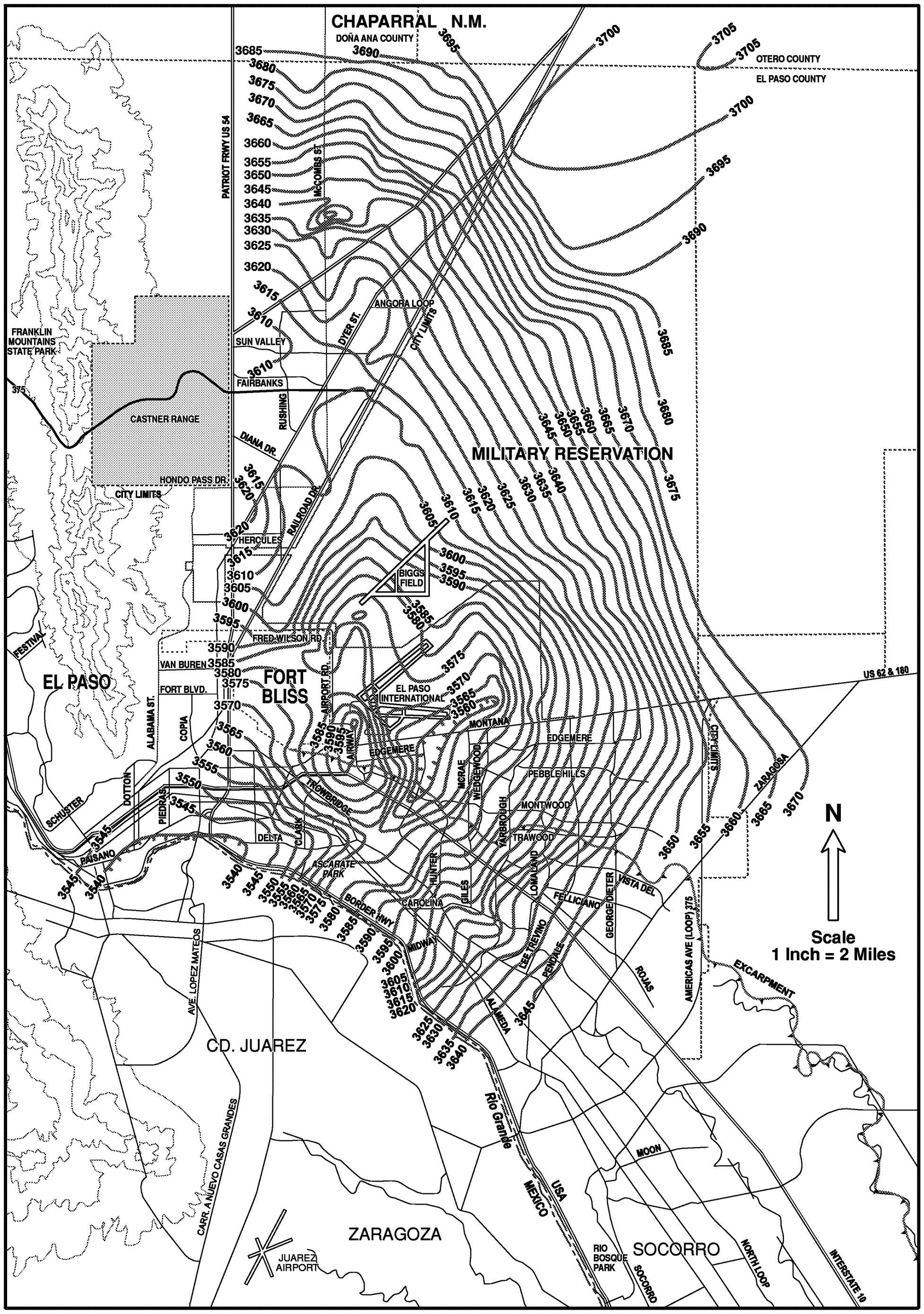
Under predevelopment conditions (circa 1920), the Rio Grande was alternately a discharge point for the Hueco Bolson Aquifer and a source of recharge (Groschen 1994). The majority of the present groundwater discharge from the Hueco Bolson is due to pumping withdrawals for municipal, industrial, irrigation, and military water supply. In heavily developed areas of the bolson, water level has declined in the aquifer by approximately 147 feet since 1940, with developed cones of depression at the Mesa and Montana municipal well fields located in the vicinity of the EPIA (**Figure F-2**) and in well fields serving Ciudad Juárez. Municipal pumping has locally altered the direction of groundwater flow towards the pumping centers (**Figure F-3**).

Groundwater resources in the upper Hueco Bolson outside of the El Paso area have not been developed extensively. Currently, the largest producer of groundwater on the New Mexico side of the state line is Chaparral Water Company. Historically, the military has intermittently operated a small capacity well at the old Hueco Camp on the Doña Ana Range – North Training Areas, two wells at the Doña Ana Range Camp, and a small well field on alluvial fans adjacent to the White Sands Missile Range (WSMR). However, areas of the upper Hueco Bolson Aquifer that underlie military properties in New Mexico remain substantially undeveloped.



Source: Groschen 1994

Figure F-2. Estimated Predevelopment Water Table Elevation, Hueco Bolson Aquifer



Source: EPWU 1995

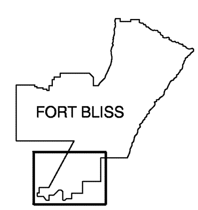


Figure F-3. Elevation of Water Table in the Mesa and Potentiometric Surface in the El Paso Area

The Hueco Bolson-Tularosa Aquifer is replenished by mountain front recharge by seepage from the Rio Grande, canals, and agricultural drains, and by deep-well injection. Water enters groundwater through storm runoff in alluvial fan areas adjacent to the Organ and Franklin mountains. Recharge on the east side of the basin is less significant, as surface water from the Hueco Mountains drains primarily to the east, and because of the fine-grained basin-fill deposits near the Hueco Mountains.

Caliche occurs nearly everywhere beneath the surface of the bolson and is a relatively effective barrier to the infiltration of rainfall. The caliche beds are partially or completely missing beneath depressions in the bolson, however, and recharge to the underlying aquifer takes place when water collects in depressions during periods of heavy rainfall (Knowles and Kennedy 1958). Subsurface recharge also occurs as underflow from the Tularosa Basin along the northern boundary of the Hueco Bolson and from the Mesilla Bolson through Fillmore Pass between the Franklin and Organ mountains (Orr and Risser 1992). Prior to the development of the aquifer for potable water supply, bolson groundwater discharged naturally to the Rio Grande. Pumping of water from the bolson has reversed the hydraulic gradients, making it necessary to line the river channel with concrete to minimize water loss. Unlined irrigation canals and drains also leak poor quality water into the aquifer. Since 1984, the Fred Hervey Water Reclamation Plant has produced approximately 11,000 acre feet (AF) of drinkable water per year from the treatment of raw sewage, which is used, in part, to recharge the Hueco Bolson Aquifer. Treated wastewater provided approximately 7,600 AF of recharge in 2003 (Cardenas 2004).

F.2 AQUIFER CHARACTERISTICS

Reported hydrogeologic characteristics of the basin-fill deposits within the Hueco Bolson are summarized in **Table F-1**. The aquifer hydraulic conductivity describes the rate at which fluids move through a formation and is determined by water-transmitting openings (pores and fractures) and the characteristics of the water. The hydraulic conductivity may vary laterally and vertically resulting in differing flow rates depending on direction. Because of layering in the basin fill deposits, the vertical hydraulic conductivity in the Hueco Bolson Aquifer is small compared to the horizontal hydraulic conductivity. This is attributed to interlayering of clay throughout most of the basin-fill deposits. Table F-1 shows horizontal conductivity. The aquifer transmissivity describes the aquifer capacity to transmit water and is a function of the hydraulic conductivity and the saturated aquifer thickness. Regional modeling of groundwater flow in the Hueco Bolson Aquifer by Groschen (1994) and Heywood and Yager (2003) utilized available data to develop optimized parameters to describe the Hueco Bolson Aquifer.

Table F-1. Hueco Bolson Aquifer Characteristics

Aquifer	Horizontal Conductivity (ft/day)	Transmissivity (ft^2/day)		Source
Basin fill	15 to 43	5,000 to 22,000		Knowles and Kennedy 1958
Basin fill	5 to 60	1,300 to 37,000		Meyer 1976
Basin fill	6 to 130	–		Lee Wilson and Association 1986
Basin fill	15 to 19	–		Orr and Risser 1992
Basin fill	1 to 40	–		Petersen et al. 1984
Basin fill	35	–		Groschen 1994
Basin fill	3 to 22	–		Heywood and Yager 2003

ft/day feet per day
ft^2/day square feet per day

Orr and Risser (1992) estimated the annual recharge rate for the Hueco Bolson from the Organ and Franklin mountains at 4,500 AF per year. Groundwater from the Tularosa Basin (3,800 AF per year) and through Fillmore Pass (260 AF per year) resulted in an estimated annual recharge to the upper Hueco Bolson Aquifer of approximately 8,560 AF per year. Heywood and Yager (2003) estimated annual recharge from irrigation return flow (11,252 AF per year), groundwater from the Tularosa Basin (5,922 AF per year), mountain front (236 AF per year), and groundwater from the Mesilla Basin (100 AF per year) for a total of 17,510 AF per year.

F.3 GROUNDWATER DRAWDOWN UNDER THE PROPOSED ACTION

EPWU modeled groundwater elevations of the Hueco Bolson in the project area with the proposed desalination project. **Figure F-4** shows the projected groundwater elevations after 50 years of pumping from the proposed feed wells and blend wells. **Figure F-5** depicts projected elevations without the proposed project (No Action Alternative).

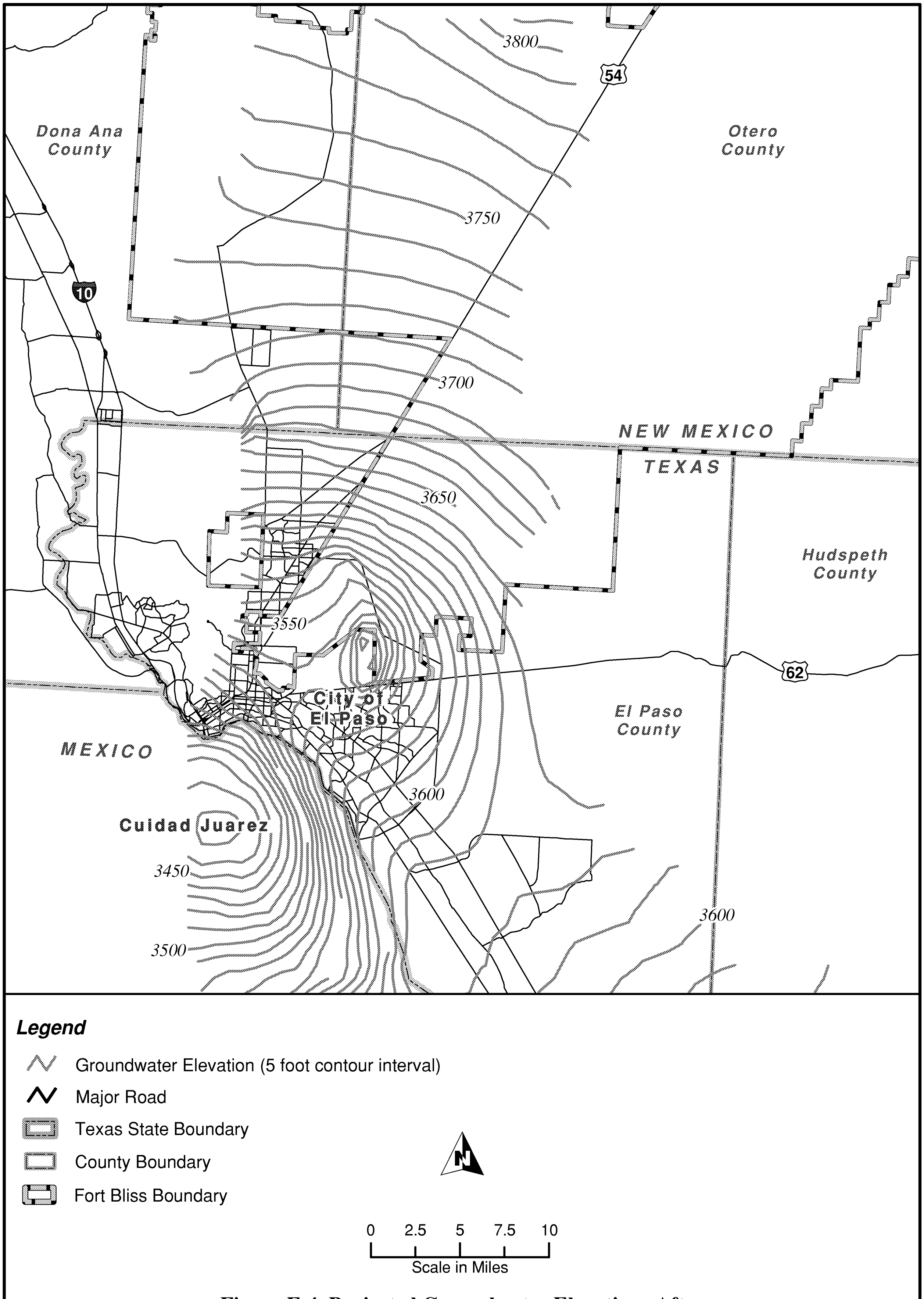


Figure F-4. Projected Groundwater Elevations After 50 Years of Pumping for the Proposed Desalination Project

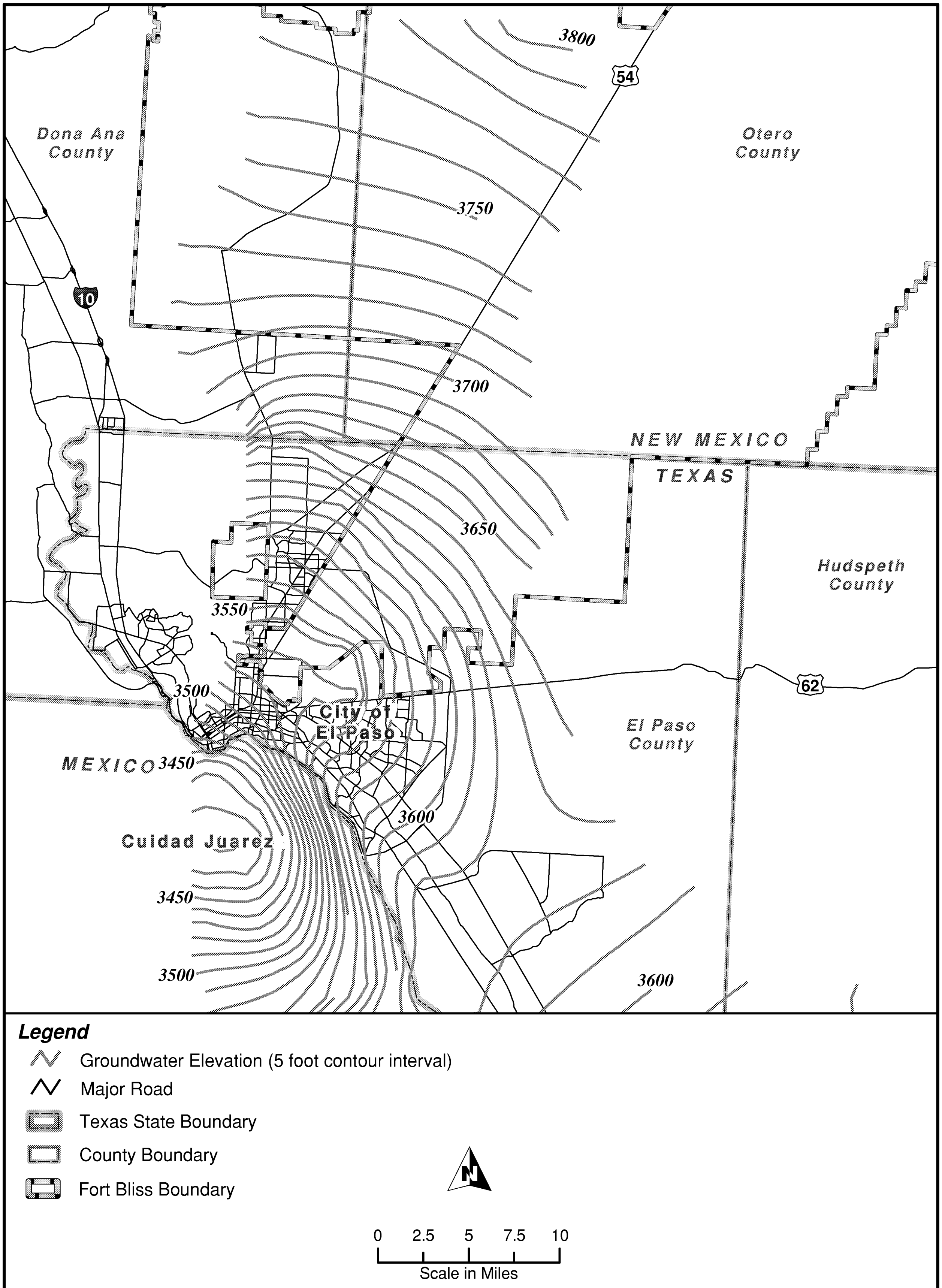


Figure F-5. Projected Groundwater Elevations in 50 Years Without the Proposed Desalination Project

Appendix G

Air Quality Modeling Assumptions

Building Construction Data

Assumptions:

Desalination Plant	Increased Area	
Administration Bldg	4000	sq ft
Process Bldg	20000	sq ft
Supporting Facilities	5000	sq ft
Storage Bldg	2000	sq ft
Pump Stations	1000	sq ft
Total Area	**32000**	**sq ft**

Emission Factors

		Emission Factors (lbs/construction period)			
Land Use	Unit of Measure	VOC	NOx	CO	PM10
General Industrial	1000 ft2 GFA	32.79	481.88	104.79	34.22

Construction Emissions

Fiscal Year	*All Alternatives Increased Area*	
FY05	32000	sq ft
Total	**32000**	sq ft

Annual Construction Emissions (For all alternatives, assuming that construction is completed within one year)

	Emissions (lbs/year)			
Fiscal Year	VOC	NOx	CO	PM10
FY05	1049.3	15420.2	3353.3	1095.0

	Emissions (tons/year)			
Fiscal Year	VOC	NOx	CO	PM10
FY05	0.5	7.7	1.7	0.5

Emissions (tons/year)				
CO	SOx	NOx	PM	VOC
1.7		7.7	0.5	0.5

Building Construction Data (Pipelines)

Assumptions:

Desalination Plant	**Increased Area**	
Pipelines (15 ft wide x 15 mile long)	118800	sq ft
Total Area	**118800**	**sq ft**

Emission Factors

		Emission Factors (lbs/construction period)			
Land Use	Unit of Measure	VOC	NOx	CO	PM10
General Industrial	1000 ft2 GFA	32.79	481.88	104.79	34.22

Construction Emissions

Fiscal Year	*All Alternatives*	
	Increased Area	
FY05	118800	sq ft
Total	**118800**	sq ft

Annual Construction Emissions (For all alternatives, assuming that construction is completed within one year)

	Emissions (lbs/year)			
Fiscal Year	VOC	NOx	CO	PM10
FY05	3895.5	57247.3	12449.1	4065.3

	Emissions (tons/year)			
Fiscal Year	VOC	NOx	CO	PM10
FY05	1.9	28.6	6.2	2.0

Emissions (tons/year)				
CO	SOx	NOx	PM	VOC
6.2		28.6	2.0	1.9

Grading Requirements

Assumptions:

Graded Area for Bldg Construction	57500 sf	(Data from Hausser)
Paved Road	25000 sf	
Parking Lot (50 vehicles)	10000 sf	

Emissions from Grading

Grading	Unit	All Alternatives	Unit
New facilities & structures	sf	57,500	sf
	acres	1.32	acres
Pavement (Parking lot, 50 vehicles)	sf	10,000	sf
	acres	0.23	acres
Pavement (Paved Road)	sf	25,000	sf
	acres	0.57	acres
TOTAL GRADED AREA	**Acres**	**1.55**	**Acres**

Grading Emission Factor 26.4 lb/acre/day

Acres/day	3
Days of grading	1

	All Alt.
PM10 Emissions (lbs/day)	21.13
PM10 Emissions (tons/year)	0.011

Grading Requirements (Alternatives 4, 5, and 6)

Assumptions:

Graded Area for Ev. Ponds 770 acres (Data from Hausser)

Emissions from Grading

Grading	Unit	All Alternatives	Unit
Evaporation Ponds	Acres	772	acres
TOTAL GRADED AREA	**Acres**	**772**	**Acres**

1 acre= 43,560 sf
770 acres= 33,628,320 sf

Grading Emission Factor 26.4 lb/acre/day

Acres/day 3
Days of grading 257

	Alt. 4,5,6
PM10 Emissions (lbs/day)	20380.8
PM10 Emissions (tons/year)	10.2

<u>Grading Equipment</u>

Grading Rate 3 (acres/day)
130680 (sq ft/day)
Workday 8 (hr/day)

	All Alt.
Days of grading activity	257
Hours of paving activity	2056

		Emission Factor (lb/hour)				
Equipment		CO	VOC	NOx	SOx	PM10
Bulldozer		2.100	0.420	4.411	0.420	0.105
Motor Grader		0.376	0.054	1.235	0.107	0.054
Water Truck		0.300	0.065	0.870	0.067	0.050

Alternatives 4, 5, 6			Emissions (tons/year)				
Equipment	Equipment	Hours	CO	VOC	NOx	SOx	PM10
Bulldozer	1	2056	2.2	0.4	4.534	0.4	0.1
Motor Grader	1	2056	0.4	0.1	1.3	0.1	0.1
Water Truck	1	2056	0.3	0.1	0.9	0.1	0.1

Total Emissions - Grading

	Emissions (tons/year)				
	CO	VOC	NOx	SOx	PM10
Alternatives 4, 5, 6	2.5	0.5	5.8	0.5	0.2

Emissions (tons/year)				
CO	**SOx**	**NOx**	**PM**	**VOC**
2.5	0.5	5.8	10.4	0.5

Emissions from Paving

Assumptions:

Paved Road	25000 sf
Parking Lot (50 vehicles)	10000 sf

	All Alternatives		
Paved Road	1,000	ft	length
	25	ft	width
	25,000	sf	
Parking Lot (50 vehicles)	10,000	sf	
Total Paved Area	35,000	sf	

Dump Truck to Import Paving Materials

Pavement depth (ft)	0.5	
Pavement volume (cu ft)	17500	
Pavement volume (cu yd)	1944	
Miles per round trip	90	Guesstimate
Size of truckload (cu yd)	10	Typical size of dump truck
Total trips	194	(gravel volume) / (volume/truck)
Total miles	17500	(trips) x (miles/trip)

		Emission Factor (g/mi)				
Vehicle Type		**CO**	**VOC**	**NOx**	**SOx**	**PM**
HDDV		20.26	5.60	18.53	0.09	1.65

Pavement Hauling Emissions

		Emissions (tons/year)				
	Total Miles	**CO**	**VOC**	**NOx**	**SOx**	**PM**
All Alternatives	17500	0.4	0.1	0.4	0.0	0.0

Installation of New Asphalt

Paving Rate 5000 (sq ft/day)

Workday 8 (hr/day)

	All Alt.
Days of paving activity	7
Hours of paving activity	56

		Emission Factor (lb/hour)				
Equipment		CO	VOC	NOx	SOx	PM10
Bulldozer		2.100	0.420	4.411	0.420	0.105
Asphalt Paver		0.376	0.054	1.235	0.107	0.054
Roller		0.300	0.065	0.870	0.067	0.050

All Alternatives			Emissions (tons/year)				
Equipment	# Eq	Hours	CO	VOC	NOx	SOx	PM10
Bulldozer	1	56	0.1	0.0	0.124	0.0	0.0
Asphalt Paver	1	56	0.0	0.0	0.0	0.0	0.0
Roller	1	56	0.0	0.0	0.0	0.0	0.0

Total Emissions - Paving Operation

	Emissions (tons/year)				
	CO	VOC	NOx	SOx	PM10
All Alternatives	0.5	0.1	0.5	0.0	0.0

Emissions (tons/year)				
CO	**SOx**	**NOx**	**PM**	**VOC**
0.5	0.02	0.5	0.04	0.1

Emissions from Commuting Vehicles (Alt 1,2,3)

Assumptions:

No. of construction employees	25
Commuting Distance	20 miles
Vehicle Occupancy	1.1 person/vehicle

POV Emission Factors
(from Jagelski & O'Brien, 1994)

(High Altitude > 4,000 feet)

	Calendar Year	CO (g/mi)	VOC (g/mi)	NOx (g/mi)	SOx (g/mi)	PM (g/mi)
POV	1990	33.850	4.080	2.160	0.005	0.082
POV	1995	20.600	2.820	1.670	0.005	0.078

(Low Altitude <= 4,000 feet)

	Calendar Year	CO (g/mi)	VOC (g/mi)	NOx (g/mi)	SOx (g/mi)	PM (g/mi)
POV	1990	24.520	3.410	2.300	0.005	0.082
POV	1995	16.580	2.470	1.640	0.005	0.078

POV Commuting Data

Commuting Distance =	**20 miles/RT**	
Weekly schedule =	**5 days/week**	
Annual schedule =	**52 weeks/year**	
AVR =	**1.1 commuters/RT**	**AVR=Average vehicle ridership**
% of Employees Living On-Base	**- %**	**Assume on-base workers do not commute.**

Commuters	Total
Baseline	
Proposed	25

Average model year (baseline) = **1995**
Average model year (proposed) = **1995**

#RT/day = #empl/day*(%commuters/100)/AVR
#miles/yr = #miles/RT * RT/wk * wk/yr

Emission Calculation	Commuters	Daily Trips (RT/day)	Annual Miles (miles)	CO (tons)	VOC (tons)	NOx (tons)	SOx (tons)	PM (tons)
Baseline	-	-	-	0.0	0.0	0.0	0.0	0.0
Proposed	25	23	118,182	2.2	0.3	0.2	0.0	0.0

Emissions (tons/year)				
CO	SOx	NOx	PM	VOC
2.2	0.0	0.2	0.0	0.3

Emissions from Commuting Vehicles (Alts 4,5,6)

Assumptions:

No. of construction employees	30
Commuting Distance	20 miles
Vehicle Occupancy	1.1 person/vehicle

POV Emission Factors
(from Jagelski & O'Brien 1994)

(High Altitude > 4,000 feet)

	Calendar Year	CO (g/mi)	VOC (g/mi)	NOx (g/mi)	SOx (g/mi)	PM (g/mi)
POV	1990	33.850	4.080	2.160	0.005	0.082
POV	1995	20.600	2.820	1.670	0.005	0.078

(Low Altitude <= 4,000 feet)

	Calendar Year	CO (g/mi)	VOC (g/mi)	NOx (g/mi)	SOx (g/mi)	PM (g/mi)
POV	1990	24.520	3.410	2.300	0.005	0.082
POV	1995	16.580	2.470	1.640	0.005	0.078

POV Commuting Data

Commuting Distance =	**20 miles/RT**	
Weekly schedule =	**5 days/week**	
Annual schedule =	**52 weeks/year**	
AVR =	**1.1 commuters/RT**	**AVR=Average vehicle ridership**
% of Employees Living On-Base	**- %**	**Assume on-base workers do not commute.**

Commuters	Total
Baseline	
Proposed	30

Average model year (baseline) = **1995**
Average model year (proposed) = **1995**

#RT/day = #empl/day*(%commuters/100)/AVR
#miles/yr = #miles/RT * RT/wk * wk/yr

Emission Calculation	Commuters	Daily Trips (RT/day)	Annual Miles (miles)	CO (tons)	VOC (tons)	NOx (tons)	SOx (tons)	PM (tons)
Baseline	-	-	-	0.0	0.0	0.0	0.0	0.0
Proposed	30	27	141,818	2.6	0.4	0.3	0.0	0.0

Emissions (tons/year)				
CO	SOx	NOx	PM	VOC
2.6	0.0008	0.3	0.012	0.4

Emissions from Commuting Vehicles (Operations)

Assumptions:

No. of employees working at the plant	25
Commuting Distance	20 miles
Vehicle Occupancy	1 person/vehicle

POV Emission Factors
(from Jagelski & O'Brien, 1994)

(High Altitude > 4,000 feet)

	Calendar Year	CO (g/mi)	VOC (g/mi)	NOx (g/mi)	SOx (g/mi)	PM (g/mi)
POV	1990	33.850	4.080	2.160	0.005	0.082
POV	1995	20.600	2.820	1.670	0.005	0.078

(Low Altitude <= 4,000 feet)

	Calendar Year	CO (g/mi)	VOC (g/mi)	NOx (g/mi)	SOx (g/mi)	PM (g/mi)
POV	1990	24.520	3.410	2.300	0.005	0.082
POV	1995	16.580	2.470	1.640	0.005	0.078

POV Commuting Data

Commuting Distance =	**20 miles/RT**	
Weekly schedule =	**5 days/week**	
Annual schedule =	**52 weeks/year**	
AVR =	**1.1 commuters/RT**	**AVR=Average vehicle ridership**
% of Employees Living On-Base	**- %**	**Assume on-base workers do not commute.**

Commuters	Total
Baseline	
Proposed	25

Average model year (baseline) = **1995**
Average model year (proposed) = **1995**

#RT/day = #empl/day*(%commuters/100)/AVR
#miles/yr = #miles/RT * RT/wk * wk/yr

Emission Calculation

	Commuters	Daily Trips (RT/day)	Annual Miles (miles)	CO (tons)	VOC (tons)	NOx (tons)	SOx (tons)	PM (tons)
Baseline	-	-	-	0.0	0.0	0.0	0.0	0.0
Proposed	25	23	118,182	2.2	0.3	0.2	0.0	0.0

Emissions (tons/year)				
CO	SOx	NOx	PM	VOC
2.2	0.0	0.2	0.0	0.3

Fleet Emission Factors

Jagielski, K. and O'Brien, J. 1994. *Calculations Methods for Criteria Air Pollution Emission Inventories*, USAF, Armstrong Laboratory, AL/OE-TR-1994-0049. Brooks AFB.

See below for sulfur calculations, which are based on %S in fuel, etc.

1990 Average model year.

High Altitude >4,000 ft.

Vehicle Type	**CO (g/mi)**	**VOC (g/mi)**	**NOx (g/mi)**	**SOx (g/mi)**	**PM (g/mi)**	**Reference** (from Jagelski & O'Brien, 1994)	
POV	33.85	4.08	2.16	0.005	0.082	(from Jagelski & O'Brien, 1994)	privately-owned vehicles
LDGV	27.27	1.9	1.5	0.005	0.022	(from Jagelski & O'Brien, 1994)	light-duty gasoline-fueled vehicles designed to transport 12 people or fewer
LDGT	39.34	2.76	1.84	0.007	0.022	(from Jagelski & O'Brien, 1994)	light-duty gasoline-fueled trucks with GVW <= 8,500 lbs
HDGV	93.95	4.03	4.01	0.011	0.102	(from Jagelski & O'Brien, 1994)	heavy-duty gasoline-fueled vehicles with GVW >8,500 lbs
LDDV	2.07	0.78	1.45	0.038	0.2	(from Jagelski & O'Brien, 1994)	light-duty diesel-powered vehicles designed to transport 12 people or fewer
LDDT	3.25	1.03	1.53	0.053	0.26	(from Jagelski & O'Brien, 1994)	light-duty diesel-powered trucks with GVW <= 8,500 lbs
HDDV	20.26	5.6	18.53	0.088	1.652	(from Jagelski & O'Brien, 1994)	heavy-duty diesel-powered vehicles with GVW > 8,500 lbs

1995 Average model year.

High Altitude >4,000 ft.

Vehicle Type	**CO (g/mi)**	**VOC (g/mi)**	**NOx (g/mi)**	**SOx (g/mi)**	**PM (g/mi)**	**Reference** (from Jagelski & O'Brien, 1994)	
POV	20.6	2.82	1.67	0.005	0.078	(from Jagelski & O'Brien, 1994)	privately-owned vehicles
LDGV	15.58	1.17	1.29	0.005	0.022	(from Jagelski & O'Brien, 1994)	light-duty gasoline-fueled vehicles designed to transport 12 people or fewer
LDGT	23.87	1.8	1.58	0.007	0.022	(from Jagelski & O'Brien, 1994)	light-duty gasoline-fueled trucks with GVW <= 8,500 lbs
HDGV	60.63	2.94	3.86	0.011	0.102	(from Jagelski & O'Brien, 1994)	heavy-duty gasoline-fueled vehicles with GVW >8,500 lbs
LDDV	1.52	0.5	1.12	0.038	0.2	(from Jagelski & O'Brien, 1994)	light-duty diesel-powered vehicles designed to transport 12 people or fewer
LDDT	2.61	0.73	1.21	0.053	0.26	(from Jagelski & O'Brien, 1994)	light-duty diesel-powered trucks with GVW <= 8,500 lbs
HDDV	18.69	4.91	10.81	0.088	1.652	(from Jagelski & O'Brien, 1994)	heavy-duty diesel-powered vehicles with GVW > 8,500 lbs

1990 Average model year.

Low Altitude <=4,000 ft.

Vehicle Type	**CO (g/mi)**	**VOC (g/mi)**	**NOx (g/mi)**	**SOx (g/mi)**	**PM (g/mi)**	**Reference** (from Jagelski & O'Brien, 1994)	
POV	24.52	3.41	2.3	0.005	0.082	(from Jagelski & O'Brien, 1994)	privately-owned vehicles

LDGV	20.36	1.71	1.61	0.005	0.022	(from Jagelski & O'Brien, 1994)	light-duty gasoline-fueled vehicles designed to transport 12 people or fewer
LDGT	27.42	2.39	2.05	0.007	0.022	(from Jagelski & O'Brien, 1994)	light-duty gasoline-fueled trucks with GVW <= 8,500 lbs
HDGV	59.83	3.27	5.81	0.011	0.102	(from Jagelski & O'Brien, 1994)	heavy-duty gasoline-fueled vehicles with GVW >8,500 lbs
LDDV	1.56	0.6	1.45	0.038	0.2	(from Jagelski & O'Brien, 1994)	light-duty diesel-powered vehicles designed to transport 12 people or fewer
LDDT	1.67	0.72	1.55	0.053	0.26	(from Jagelski & O'Brien, 1994)	light-duty diesel-powered trucks with GVW <= 8,500 lbs
HDDV	12.29	2.51	18.53	0.088	1.652	(from Jagelski & O'Brien, 1994)	heavy-duty diesel-powered vehicles with GVW > 8,500 lbs

1995 Average model year.

Low Altitude <=4,000 ft.

Vehicle	**CO**	**VOC**	**NOx**	**SOx**	**PM**	**Reference**	
Type	**(g/mi)**	**(g/mi)**	**(g/mi)**	**(g/mi)**	**(g/mi)**	(from Jagelski & O'Brien, 1994)	
POV	16.58	2.47	1.64	0.005	0.078	(from Jagelski & O'Brien, 1994)	privately-owned vehicles
LDGV	13.2	1.12	1.22	0.005	0.022	(from Jagelski & O'Brien, 1994)	light-duty gasoline-fueled vehicles designed to transport 12 people or fewer
LDGT	18.49	1.63	1.63	0.007	0.022	(from Jagelski & O'Brien, 1994)	light-duty gasoline-fueled trucks with GVW <= 8,500 lbs
HDGV	36.39	2.42	4.93	0.011	0.102	(from Jagelski & O'Brien, 1994)	heavy-duty gasoline-fueled vehicles with GVW >8,500 lbs
LDDV	1.4	0.47	1.12	0.038	0.2	(from Jagelski & O'Brien, 1994)	light-duty diesel-powered vehicles designed to transport 12 people or fewer
LDDT	1.52	0.6	1.21	0.053	0.26	(from Jagelski & O'Brien, 1994)	light-duty diesel-powered trucks with GVW <= 8,500 lbs
HDDV	11.22	2.16	10.81	0.088	1.652	(from Jagelski & O'Brien, 1994)	heavy-duty diesel-powered vehicles with GVW > 8,500 lbs

SOx Emission Factors

S = sulfur content of fuel (S)	ppm	%	Fuel	Ref
	80	0.008	Gasoline	http://www.chevron.com/prodserv/fuels/bulletin/phase2rfg/char.shtml
	500	0.05	Diesel	http://www.chevron.com/prodserv/fuels/bulletin/diesel/L2_3_9_rf.htm

Typical Fuel Economy (X)	MPG	Diesel		Gasol.		http://www1.faa.gov/arp/app600/ileav/Technical_Report.doc
Heavy Duty Trucks	6-8	6	HDDV	7.5	HDGV	
Medium Duty Trucks	10-14	10	LDDT	12.5	LDGT	
Light Duty Trucks/Cars	16-24	14	LDDV	17.5	LDGV	

Density of fuel (D)

Diesel	7	lb/gal

Gasoline	7	lb/gal

Emission Factor for SO2

EF (g/mi) = (1 gal fuel/X miles) * (D lb fuel/1 gal fuel) * (453.6 g/lb) * (S g sulfur/1,000,000 g fuel) * (64.06 g SO2/32.06 g S)

	SOx (g/mi)	
POV	0.005	privately-owned vehicles
LDGV	0.005	light-duty gasoline-fueled vehicles designed to transport 12 people or fewer
LDGT	0.007	light-duty gasoline-fueled trucks with GVW <= 8,500 lbs
HDGV	0.011	heavy-duty gasoline-fueled vehicles with GVW >8,500 lbs
LDDV	0.038	light-duty diesel-powered vehicles designed to transport 12 people or fewer
LDDT	0.053	light-duty diesel-powered trucks with GVW <= 8,500 lbs
HDDV	0.088	heavy-duty diesel-powered vehicles with GVW > 8,500 lbs

Emissions Summary

Alternatives 1, 2, and 3

	Emissions (tons/year)				
Source	**CO**	**SOx**	**NOx**	**PM**	**VOC**
Construction (Infrastructure)	1.7	0.00	7.7	0.5	0.5
Grading (Infrastructure)				0.01	
Paving (Paved Road & Parking Lot)	0.5	0.02	0.5	0.04	0.1
Construction (Pipelines)	6.2	0.00	28.6	2.0	1.9
Commuting POV	2.2	0.0006	0.21	0.01	0.3
Total Construction	**10.5**	**0.02**	**37.1**	**2.6**	**2.9**
Commuting POV	2.2	0.001	0.2	0.01	0.3
Total Operation	**2.2**	**0.001**	**0.2**	**0.01**	**0.3**

Alternatives 4, 5, and 6

	Emissions (tons/year)				
Source	**CO**	**SOx**	**NOx**	**PM**	**VOC**
Construction (Infrastructure)	1.7	0.00	7.7	0.5	0.5
Grading (Infrastructure)				0.01	
Grading (Evaporation Ponds)	2.5	0.5	5.8	10.4	0.5
Paving (Paved Road & Parking Lot)	0.5	0.0	0.5	0.04	0.1
Construction (Pipelines)	6.2	0.0	28.6	2.0	1.9
Commuting POV	2.6	0.0008	0.3	0.012	0.4
Total Construction	**13.5**	**0.6**	**42.9**	**13.0**	**3.5**
Commuting POV	2.2	0.001	0.2	0.01	0.3
Total Operation	**2.2**	**0.001**	**0.2**	**0.01**	**0.3**

ACRONYMS AND ABBREVIATIONS

ºF	degrees Fahrenheit
µg/m³	micrograms per cubic meter
µm	micron
AADT	Annual Average Daily Traffic
AAF	Army Airfield
AF	acre-feet
BLS	below land surface
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Restoration, Compensation and Liability Act
CFR	Code of Federal Regulations
CO	carbon monoxide
dB	decibel
DOD	Department of Defense
EIS	Environmental Impact Statement
EPCWID	El Paso County Water Irrigation District
EPCRA	Emergency Planning and Community Right-to-Know Act
EPIA	El Paso International Airport
EPWU	El Paso Water Utilities
FAA	Federal Aviation Administration
FHWRP	Fred Hervey Water Reclamation Plant
HDPE	high-density polyethylene
ICRMP	Integrated Cultural Resources Management Plan
IRP	Installation Restoration Program
L_{dn}	Day-Night Average Sound Level
LOS	Level of Service
LPST	leaking petroleum storage tank
mg/kg	milligrams per kilograms
mg/l	milligrams per liter
MGD	million gallons per day
mph	miles per hour
MPO	Metropolitan Planning Organization
MVA	megavolt-amperes
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLR	Noise Level Reduction
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NRHP	National Register of Historic Places
NSR	New Source Review
O_3	ozone
OSHA	Occupational Safety and Health Act
Pb	lead
PEIS	Programmatic Environmental Impact Statement
PM_{10}	particulate matter less than 10 micrometers in diameter
$PM_{2.5}$	particulate matter 2.5 microns or less in diameter
POV	privately owned vehicle
ppm	parts per million
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
PVC	polyvinyl chloride
QC/QA	Quality Control/Quality Assurance
RCRA	Resource Conservation and Recovery Act
RO	reverse osmosis
ROI	region of influence
RSWP	Regional Sustainable Water Project
RT	round trip
SIC	Standard Industrial Code
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_x	sulfur oxides
SWDA	Solid Waste Disposal Act
TA	Training Area
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
THC	Texas Historical Commission
tpd	tons per day
TSP	total suspended particles
TWDB	Texas Water Department Board
TxDOT	Texas Department of Transportation
UIC	Underground Injection Control
U.S.	United States
US 54	U.S. Highway 54
USC	United States Code
USDW	underground source of drinking water
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WDA	Workforce Development Area